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CONTENTS

Observations on the Use of the Sucking-fish or Remora, *Echeneis naucrates*, for Catching Turtles in Cuban and Colombian Waters

By C. Ralph De Sola

Introduction

In reading several interesting papers of Dr. E. W. Gudger (1919), that indefatigable research worker in the bibliography of ichthyology, my attention was arrested by the title and contents of a brochure "On the Use of the Sucking-fish for Catching Fish and Turtles." In some fifty pages and with less than a dozen illustrations he has skillfully demonstrated and proven the story of the use man found for the sucking-fish. He states that the custom of using the remora for fishing was first observed by Columbus (1494) on his second voyage to America, in an island group of the West Indies called the Jardinellas de la Reina.

In conversation with Dr. Gudger I told him of similar observations by myself and others in Cuban waters, and of those of my father, Dr. Solomon De Sola, off the north coast of Colombia. At Dr. Gudger's instigation I relate these experiences, offer some extensions to his paper and comment on the writings of other authors who have treated upon this subject of remora fishing.

Remora Fishing Locations Other Than Cuban

It is interesting to discover in Gudger's paper that remora fishing is not confined to Cuban waters but occurs in many parts of the world. These localities are summarized:

Africa: Isle de France (Mauritius), Zanzibar, and east coast of continent from Mozambique to Natal and including the island of Madagascar. From the 5th to the 30th parallel of south latitude and from 30 to 60 degrees east longitude.

Asia: along the South China Sea and the locale of Singapore. From the Equator to 20 degrees north latitude and in 105 degrees east longitude.

Australia: in the vicinity of North Queensland at Cape York, Torres Straits (between Queensland and New Guinea), Dunk Island (tropical Queensland), and Prince of Wales Island at the north-east extremity of the Gulf of Carpentaria. From 8 to 10 degrees in the south latitudes and in the 140th degree of east longitude.

South America and West Indies: off La Guayra, Venezuela, and at Puerto Colombia, Colombia. In Cuba, Haiti and Jamaica. From the 10th to the 25th parallel of north latitude and from the 65th to the 85th degree of west longitude.

Obviously it is the work of the ethnologist to determine the origin of this peculiar custom having such cosmopolitan range, for until further researches have been made it would be foolhardy to state that the custom was an invention of the American aborigines and of a pre-Columbian date only in the New World.

Remora Fishing in the Jardinellas de la Reina

Gudger gives considerable space to tracing accounts by Spanish historians who recorded the incident of remora fishing seen by Columbus in the

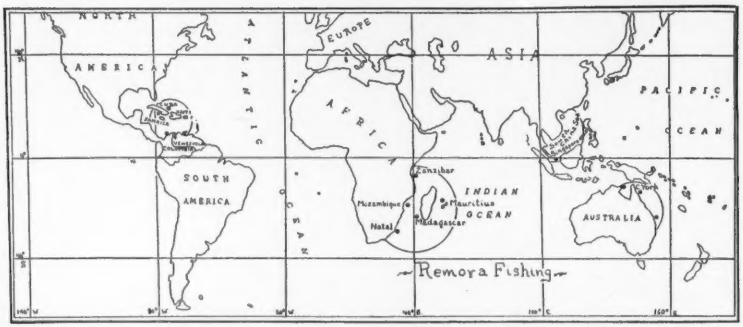

Fig. 1. Outline map of World on mercator projection, showing localities where remora fishing is practised, indicated by black dots.

Jardinellas de la Reina. All these accounts appear to be repetitions of Peter Martyr. MacNutt's excellent translation of his "Decades" follows:

Everybody has assured me that they have seen fishermen use this fish just as commonly as we chase hares with French dogs, or pursue the wild deer with Molossians. They say that this fish makes good eating. It is shaped like an eel, and is no larger. It attacks fish larger than itself, or turtles larger than a shield; it resembles a weasel seizing a pigeon or still larger animal by its throat, and never leaving go until it is dead. Fishermen tie this fish to the side of their barque, for it must not be exposed to the bright sun, from which it shrinks.

The most extraordinary thing is that it has at the back of its head a sort of very tough pocket. As soon as the fisherman sees any fish swimming near the barque, he gives the signal for attack and lets go the little cord. Like a dog freed from its leash, the fish descends on its prey and turning its head throws the skin pouch over the neck of the victim, if it is a large fish. On the contrary, if it is a turtle, the fish attaches itself to the place where the turtle protrudes from its shell, and never lets go till the fisherman pulls it with a little cord to the side of the barque....If, on the contrary, a turtle has been caught, the fishermen spring into the sea and raise the animal on their shoulders to within reach of their companions. When the prey is in the barque, the hunting-fish returns to its place and never moves, save when they give it a piece of the animal, just as one gives a bit of quail to a falcon:...The Spaniards call this fish Reverso, meaning one who turns around, because it is when turning that it attacks and seizes the prey with its pocket-shaped skin.

Location of Isles Described by Columbus

A point in question has been the location of the Jardinellas de la Reina and Gudger in quoting the Spanish historian Bernaldez (MS ante 1500) writes:

The Admiral set sail (from Jamaica) with his three caravels, and sailed 24 leagues towards the west, as far as the Gulf Buen Tiemps...Whitsunday, 1494.

A glance at any chart of the West Indian region leaves one with the impression that from the foregoing account Columbus arrived twenty-four leagues to the west of Jamaica and when this route is checked with dividers and parallel rulers one finds a spot in the Caribbean Sea far distant from any islands. Making allowances for the discrepancies of navigation as known to Columbus, and taking into account that his maps were, at best, his own rough sketches of unmapped territory, and that he had no knowledge of the local magnetic variations or even the deviations aboard

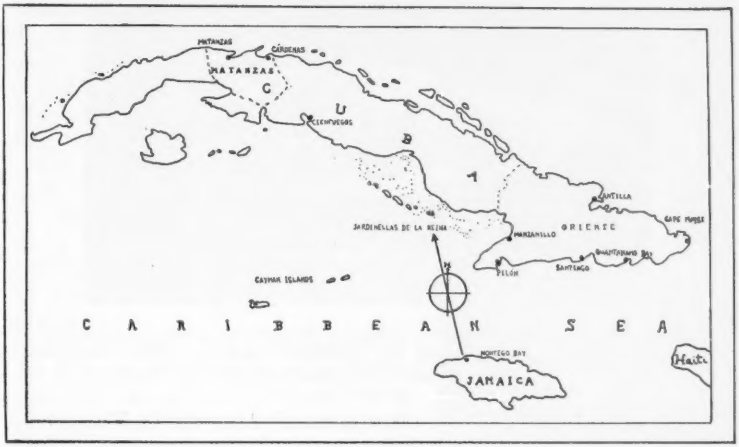

Fig. 2. Cuba and Jamaica with route taken by Columbus to the Jardinellas de la Reina (Jardines de la Reina, modern form) where remora fishing was first observed. The Cuban place names mentioned in the article are also given.

his vessel, nor of the currents and their speeds, one must reconstruct his voyage and determine what course he made to reach the islands. The writer's method follows:

Twenty-four leagues reduced gives a sailing distance of 115.2 nautical miles.

Using Montego Bay, Jamaica (this being the northernmost port of that island) as a point of departure, we can extend our dividers on the Hydrographic Office chart of the West Indies to a distance equal to 115.2 nautical miles and the arc described will fall in the Bight of Manzanillo where islands called the Jardines de la Reina are located. This method gives us a course of 348.5 degrees or North by West.

While it is true that the arc just described cuts the east end of Cayman Brac, it must be borne in mind that the Cayman Islands are a sandy and almost treeless group of three islands, while the Jardinellas de la Reina (Gardens of the Queen), as their name implies, are well wooded and consist of over four hundred cays. Bernaldez writes:

> **On Whitsunday, 1494, they stopped at a place which was uninhabited—but not from the inclemency of the sky, or the barrenness of the soil,—in the midst of a large grove of palm-trees, which seemed to reach from the sea shore to the very heavens...as the number of islands in this was so great that he could not give each a separate name, the Admiral called them all by the common name of the Queen's Garden.**

Aboard the steamer "Cananova" enroute to Cienfuegos from Manzanillo, the writer passed these islands and can testify to their tropical luxuriance of foliage and to the vast numbers of royal palms that surmount the lush landscape.

De la Torre and Aguayo in their Cuban Geography say (author's translation):

> **From Cape Cruz to Port Casilda:—in this region of the littoral are two gulfs: that of Guacanayabo and that of Ana Maria. The coast line is low and broken up with more than 400 cays, which form the archipelago discovered by Columbus, called the Jardines de la Reina.**

It has been the impression of many writers that the islands were near Hispaniola (Haiti) and Jamaica but I feel from the foregoing that no further doubt can exist as to their location being on the south coast of Cuba and within the Gulf of Guacanayabo.

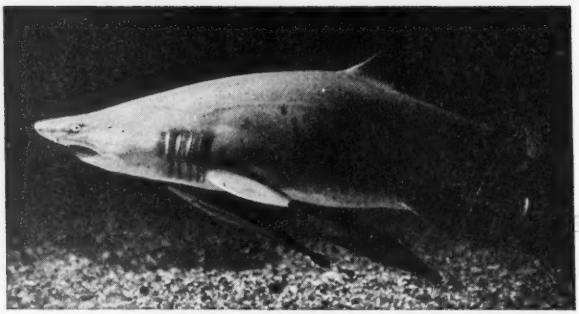

Fig. 3. Photograph of Sand Shark, *Carcharias littoralis,* with two specimens of the Remora, *Echeneis naucrates,* attached. The specimens reveal two distinct color phases. These fish are capable of eight color phases according to Townsend.

Remora Fishing in the Jardinellas de la Reina Today

Gudger traces accounts to the present day and states that for the West Indian region remora fishing has not been recorded since 1885 when Lady Anne Brassey wrote of her observations on the coast of Venezuela. In reference to the first noted site of such fishing operations, the Jardinellas de la Reina, he emphatically states:

> ...hence we may safely conclude that the Jardinellas de la Reina no longer witness the exploits of the fisherman fish.

The writer presents findings that would seem to refute Dr. Gudger's statement. While in the region of these celebrated islands, Raoul A. Bertot, the American Consular Agent at Manzanillo, a Cuban port sixty-five miles from the Jardinellas de la Reina, informed me that people of these islands practiced this custom to a considerable extent and that it was particularly employed by the Siboneyes (people of Carib extraction), who did a great deal of hawk's-bill turtle fishing. This turtle is *Eretmochelys imbricata,* the one that yields the tortoise shell of commerce. In respect to the Siboney people, de la Torre records:

> Descendants of the Siboney and some of them almost racially unmixed are found in Jiguani and Palma Soriano [these points are on the Cuban Railroad between Santiago and Manzanillo], Yateras [near Guantanamo Bay], el Caney [near Santiago], and Baracoa [near Cape Maysi on the northeast coast].

In conversation with Dr. de la Torre of the Havana University, who is the acknowledged dean of Hispanic naturalists, I was told that fishing with the remora was a hand-me-down from the Carib people and was widely practised in regions of Cuba where their descendants were to be found. The scarcity of accounts from this region is probably due to the decimation of these native fisherfolk, as the majority of Cubans are not a water loving race; in fact, all shipping is handled, operated and manned by Spanish sailors from Galicia.

Remora Fishing Locations in Cuba

Ports in Oriente Province

Manzanillo: In this port I did not have time to observe the use of the

remora but the American Consular Agent, Raoul A. Bertot, gave me information already used.

Ensenada de Mora (Pilon): Charles Mason, sub-manager of the Cape Cruz Sugar Company, informed me that fisherman on Hicacos Point used the remora as their fish-hook.

Santiago de Cuba: Emilio Portuondo, a local naturalist, told me of the strange custom and showed me a picture he had sketched depicting the fishing operation.

Guantanamo Bay (Caimanera): Here I was invited to go on a fishing party but time did not permit witnessing the exploits of echeneis. The fishermen had a pair of sucking-fish secured under the stern of their row boat. The echeneis were attached with layards secured to the caudal region of their bodies and made fast to the stern ring of the boat. The fish attached themselves with their cephalic sucking discs to the under planking.

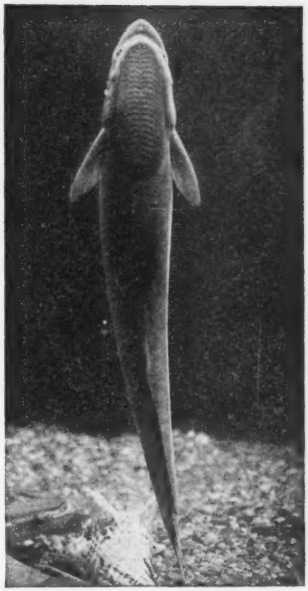

Fig. 4. Photograph of Sucking-Fish, *Echeneis naucrates*, showing detail of sucking disc.

Nipe Bay (Antilla): George Curtis of the United Fruit Company told me of the custom and showed me the fish that fished. The specimens (*E. naucrates*) were alive and tethered by their tails to a fishing jetty.

Province of Matanzas

Matanzas: See following account.

OBSERVATIONS ON REMORA FISHING AT MATANZAS, CUBA

On Sunday, April 14, 1929, it was my pleasure to go on a fishing trip for sea turtles with the American Vice-Consul, Mr. Warren C. Stewart, and a party of Cuban friends. We set out from the *marina* at daybreak and motorboated from Matanzas Bay to a village between that point and Cardenas. Here we got into several small carvel type row boats and went out off the sandy beaches with native crews. Along the lower side of the craft a pair of *pega-pegas* or *pegadores* (as sucking-fish are called in Cuba, meaning stickers) were firmly attached by their discs to the planking. A thin lanyard of *majagua* bark made them secure to the boat. This *majagua* bark is a pliable, long-fibred liana, which admirably lends itself to primitive rope making. In other parts of Cuba I saw it used as a lasso in the capture of crocodiles.

Once clear of the sandy shoal water we sighted a sea turtle basking on the surface. Our boatman immediately headed in its direction and gave us instructions to fasten the *majagua* lanyards that held the remoras to a coil of rope that was faked down in the bow. At this moment the turtle

may have sensed our presence and began to make off leisurely. The fisherman seized the sucking-fish by their heads, loosening their grasp from the boat; tossed them in the direction of the sea turtle which was about two points on our starboard bow and they swam rapidly in its direction. The lines ran out of the bow quickly and, using our hands as a check, we soon felt the lines go taut and the vibrations that came back indicated that our living fish-hooks were fast to their quarry. The fisherman implored us to hold tight and by no means to let the lines slacken as the tighter we held them the better the hold of the remora. We rowed up to the turtle, pulling in on our lines and found it to be a hawk's-bill. The fisherman made a noose fast to its neck and front flippers and with some effort we got him amidships in the boat. Once out of the water, the remoras relaxed their hold on the plastron of the turtle, the native boatman all the while indulging in much gentle talk concerning his friendship for the *pega-pegas* and reassuring them that they would be well fed and cared for on their return home. The other members of the party in their boats had the same experience except that one of them bagged two turtles during the course of the morning.

Observations on Remora Fishing in Colombia

The first and only heretofore published account of remora fishing in the waters of northern South America is from the pen of Lady Anne Brassey. She observed the custom off La Guayra and included an account of it "In the Trades, the Tropics, and the Roaring Forties." This isolated observation, the authenticity of which has been doubted, is now confirmed and fills an interregnum of many years.

Dr. Solomon De Sola, while at Puerto Colombia (Savanilla) on the Colombian coast to the westward of Venezuela, in 1920, thirty-five years after Lady Brassey's account, made observations which he thus reports:

> On the beach at Salgar, near Savanilla, my attention was called to some native fishermen and Tubura Indians who were fastening ropes of *majagua* bark about three feet in length and from one eighth to one quarter inch in diameter to the tails of sucking-fish. These remora are used to catch the edible and tortoise shell turtles found along the coast. The custom of using these fish for fishing is restricted to a few Indians and is not widely known. This is significant as there are many fishing villages along this region of the Colombian coast.

Comments

While these descriptions are not radically different from those of many authors, it is interesting to quote Dr. Jordan who, in his monumental work on *Fishes* says:

> The commonest species, *Echeneis naucrates,* called pega-pega or pegador in Cuba, reaches a length of about two feet and is almost cosmopolitan in its range, *being found exclusively on the larger sharks* notably on *Carcharias lamia.* [Italics mine.]

The specimens used near Matanzas measured 31 and 35 inches in length, and were of the same species mentioned by Jordan. The identification has been made with the use of the papers by Nichols and Breder and by Beebe and Tee Van.

At Cardenas, on the afternoon following our remora excursion, I saw turtles brought in from pound nets with remora attached to their plastra and upon inquiring whether they had anything to do with the fishing I

was informed that, on the contrary the turtles were frequently found with remora firmly attached to their undersides.

The fish's name: *remora* is a word well incorporated into the Spanish language and the dictionary of the Spanish Academy lists the word as of Greek origin and meaning: hindrance, obstacle, cause of delay. The ichthyological term for the typical genus of the sucking-fishes is directly derived from the Greek word ἐχενηὶς, from ἔχω, to hinder, and νηῦς. The Spanish lexicographer, Arturo Cuyas, gives a very similar definition of the name *remora.*

As regards the swimming powers of remora, Breder (1926) has an interesting note:

> That fishes of such natatorial powers possess such a highly specialized organ as the cephalic disc is interesting, for they have apparently suffered no particular degeneration of their power to care for themselves in a locomotor sense, for of course they must first catch their shark. In this connection, their square tail is of special significance as short spurts of speed are naturally requisite.

Regarding the adhesion of the sucking-fish, Gudger cites Townsend's experiments and paper, quoting Mr. L. L. Mowbray

> as believing that the fish under strain while under the weight of a considerable column of water *can not* relax the grip of its disc.

Townsend in writing of his own experiment says:

> By way of testing its fish-catching capacity, a shark-sucker sixteen inches long was liberated in one of the tanks of the Aquarium containing fishes. It took hold at once, and by hauling on the cord fastened to its tail a good-sized grouper was brought to the surface of the water, although it could not be lifted out of the tank. When the fish began to struggle the shark-sucker let go. When tried on a fifteen pound sea turtle, the latter could easily be drawn to the surface.
>
> There can be no doubt that with a line attached to a large remora a much larger sea turtle could be hauled in without difficulty.

Mowbray's belief is sustained by the admonitions of the boatman mentioned above to hold the line taut so as to help the remora. I have picked specimens out of the water and examination of the lamellae convinces me that this is not a local superstition but a physical fact.

Gudger gives a method of calculating the "pull" that an *Echeneis* might withstand when employed as a fish-hook and deduces that a fish with its sucking-disc having an area of 13.5 square inches could easily sustain a pull up to ninety-nine pounds.

Conclusions

1. The custom of fishing with remora is a cosmopolitan one and further researches and observations will probably reveal many new and unknown localities where the custom is in practice.
2. The Jardinellas de la Reina are located in the Bight of Manzanillo on the south coast of Cuba.
3. Remora fishing is still practised there upon the original site observed by Columbus more than four centuries ago.
4. With the exception of Matanzas, the remora fishing locations in Cuba are near or at places where descendants of the Carib people reside.
5. Thirty-five years elapsed between the observations made on the South American coast by Lady Brassey (1885) and by Dr. De Sola (1920). The custom is probably still in existence in Venezuelan waters.

6. *Echeneis naucrates* is not found exclusively on the larger sharks but is also seen on sea turtles.

7. Owing to the arrangement of the lamellae it is impossible for the remora to relax its hold when tension is placed on its horizontal axis.

8. From experimental evidence and observations there can be no doubt that the remora is capable of seizing on to sea turtles of considerable size and weight.

ACKNOWLEDGMENTS

The author wishes to express his gratitude for the critical analysis extended by Dr. E. W. Gudger and Dr. Carl L. Hubbs. The excellent photographs made by Elwin R. Sanborn are reproduced with his kind permission. I remain much indebted to Fredrica Abrams for her generous contribution in the typing and editing of this paper. The value of her help is inestimable.

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Some Strange Teleost Skulls and Their Derivation from Normal Forms[1]

By William K. Gregory

THE student of the evolution of the fish skull at present has access to three sources of evidence which may throw light on the steps by which the most highly specialized skulls have been produced: (1) by comparing the less specialized with the more specialized in different groups he may work out a tentative hypothesis as to the sequence of stages; (2) he may then examine the palaeontological record of fish life, which extends from early Palaeozoic to modern times; (3) for the answer to certain morphological questions he may appeal to embryology.

In the future experimental biology may also contribute its quota to the evidence already amassed by comparative anatomy, taxonomy, palaeontology and embryology.

On the palaeontological side the student of evolution of the fish skull has access to a record that extends from early Palaeozoic times to the present day. Fortunately survivors of many of the earlier groups still persist along with their more highly evolved relatives. The comparison of these "living fossils" with their ancient and modern relatives has already often enabled the palaeichthyologist and taxonomist to work out the general sequence of types from the oldest ganoids of the Old Red Standstone to the most specialized forms of living teleosts.

The typical fish skull is a structure of great complexity, which has doubtless been diversely modelled by many intrinsic and extrinsic factors. It comprises two general systems, the neurocranium and the branchiocranium.

The neurocranium surrounds and protects the paired olfactory, optic and otic capsules; it also forms a bony chamber for the brain. The three paired capsules, in spite of infinite diversity in detail, are invariably arranged in this fore-and-aft sequence on either side of the brain trough.

The branchiocranium, lying chiefly beneath the neurocranium, includes the branchial arches and the jaws, the latter being originally derived from branchial arches. Bony plates cover the outer part of the branchiocranium, while dentigerous patches arise on the jaws, palate and pharynx.

The intrinsic factors affecting the teleost skull may be defined as those which have been initiated in the various organs of the head itself. The extrinsic factors, although apparently originating outside the head, may profoundly modify its form.

With regard to intrinsic factors affecting the form of the neurocranium, the olfactory organ in teleosts perhaps never attains the importance that it does in the sharks. Even when the olfactory region of the skull is greatly elongated, as in the mormyrids, it is doubtful whether this implies improved olfactory sense; it may be merely in order to produce an elongate tubular bill. Even the basic ganoid *Cheirolepis* from the Old Red Sand-

[1] Read at the Washington meeting of the Society, May 6, 1932.

stone (Devonian) already had a reduced olfactory chamber and a large orbit (D. M. S. Watson, 1925). Thus from the first the teleosts were predominantly "eye-brained" forms, in which the size and position of the eyes profoundly affected the form of the sides and roof of the skull. Indeed we may select the paired orbits as the centers around which are grouped the *ethmo-vomer block* in front, the *cranial vault* behind, the *interorbital bridge* above and the *keel bone* below.

These units constitute the structural backbone of the skull and they have to be made strong enough to resist all the compressive, tensile and shearing forces of the thrusting locomotor apparatus behind, of the jaws in front, and of the fluid medium outside.

It is evident that the neurocranium is largely molded around the eyes. If the eyes are enlarged, the orbits increase in diameter. In some cases they may rise above the general level of the skull roof, carrying with them the inner wall of the orbit. Sometimes they even crowd the braincase and squeeze the interorbital bridge into a thin septum.

If we look at a typical teleost skull in side view we see that the surface bones of the face, including the opercular series and even the pectoral arch, are arranged around the eye in segments of circles of increasing diameter. This arrangement is plainly conditioned very early in the ontogeny of the fish. The combination of a very large eye with a short mouth and face locates the quadrate-articular joint in front of the orbits, so that the attached preoperculum and pectoral arch are squeezed into the semicircular zone between the eye and the heart. It is only in the post-larval stages, as a rule, that the mouth enlarges, the face elongates and the opercular fold extends caudad.

This circumorbital arrangement of the facial and opercular elements dates back to the protospondyl precursors of the teleosts, the late Palaeozoic *Acentrophorus* and the Triassic *Semionotus*. Thus it is one of the oldest and most fundamental features of the teleost skull. It is retained in somewhat specialized and degraded form in the garpike *Lepidosteus*. These oldest holosteans have two concentric rows of bones around the orbits, but modern teleosts retain only the inner row, which becomes variously enlarged and later often reduced.

The sides of the cranial vault are built around the otic capsules, which appear in early larval stages. The three canals and ampullae are recognizable in the larval striped bass as figured by Bigelow and Welsh. Around them form the epiotic, prootic, opisthotic or exoccipital, while the sacculus extends down into the floor of the cranium. In the lateral and occipital views of the skull of *Myoxocephalus* and of *Hemitripterus* (Fig. 1), we can see the record of the growth of the semicircular canals, surrounded by the three growth centers named above. Rhythmical growth periods are recorded in alternating light and dark bands. As the three centers grew away from each other at apparently equal rates in the transverse, vertical and fore-and-aft axes, they left a broad triradiate suture at their boundaries. This beautiful system of growth forces, which is so symmetrically balanced on either side of the midline, might yield some interesting responses to well directed experiments. Doubtless in all teleosts the growth

of the otic capsules and otoliths has had definite influence on the form of the skull; e.g., in certain fishes with low flat occiput the canals are low, and *vice versa.* Other factors influencing the height of the occiput will be considered below.

This picture also enables us to realize that the individual skull is the resultant of growth forces localized in growth centers which push each other apart as the bone grows at the periphery; thus these growing centers determine the transverse longitudinal and vertical diameters of the various regions of the skull. We can easily see how, during the course of evolution, the rates of growth have been changed in any one or more of these axes so that an originally narrow cranium has become broad in some lines, or how a skull of moderate height has become extremely high.

The neurocranium is also responsive to extrinsic stresses induced by the thrusts of the axial muscles, and to others emanating from the jaws and their muscles. The neurocranium is often wedge-shaped; this is due to the extrinsic forces. These extrinsic factors of skull form generally have to do either with changes in general body-form along the longitudinal, transverse and vertical axes, or with local expansions of the cephalic portion of the dorsal fin, or of the pectoral fins, or even of the pelvic fins.

What is true of the neurocranium also applies to the branchiocranium and to all its covering plates. Each starts from an individual center of ossification, which doubtless has an hereditary antecedent, or group of antecedents, in the genes.

Let us consider first the intrinsic factors affecting parts of the branchiocranium. The differential evolution of the bones around the mouth has produced most striking diversities in the position and form of the mouth and jaws, which in turn have brought about many changes in the length and width of the supporting parts of the skull. The basic ganoid *Cheirolepis* of the Devonian had very large predaceous jaws. The suspensorium, or hyomandibular, was inclined far backward. In more advanced members of this group, as the mouth shortens the suspensorium approaches the vertical. A. S. Woodward has long ago noted that in the earliest forerunners of the teleosts, belonging to the order Protospondyli or Holostei, the jaws were already short and the suspensorium was directed downward and forward, and that in all the more central teleosts of Mesozoic and later ages the mouth is moderate in size and the suspensorium is directed downward and then forward, as in the primitive amioids of the Jurassic. Inspection of the figures will show how easily the direction of the mouth, its position and the size of the jaws may be changed by alterations in relative growth rates in any one of these dimensions. Thus if the suspensorium deepens rapidly, the quadrate-articular joint will be lowered and the mouth will be tipped upward. If the quadrate joint moves forward, the mouth will be further tilted upward (Fig. 2), and *vice versa.*

Whenever we find in teleosts a very large mouth with a backwardly-directed suspensorium, it seems that this condition is secondary and that we have here examples of what is sometimes erroneously called a "reversal of evolution." In the muraenid eels, for example, this backward extension of the suspensorium is very probably secondary. This tendency culminates

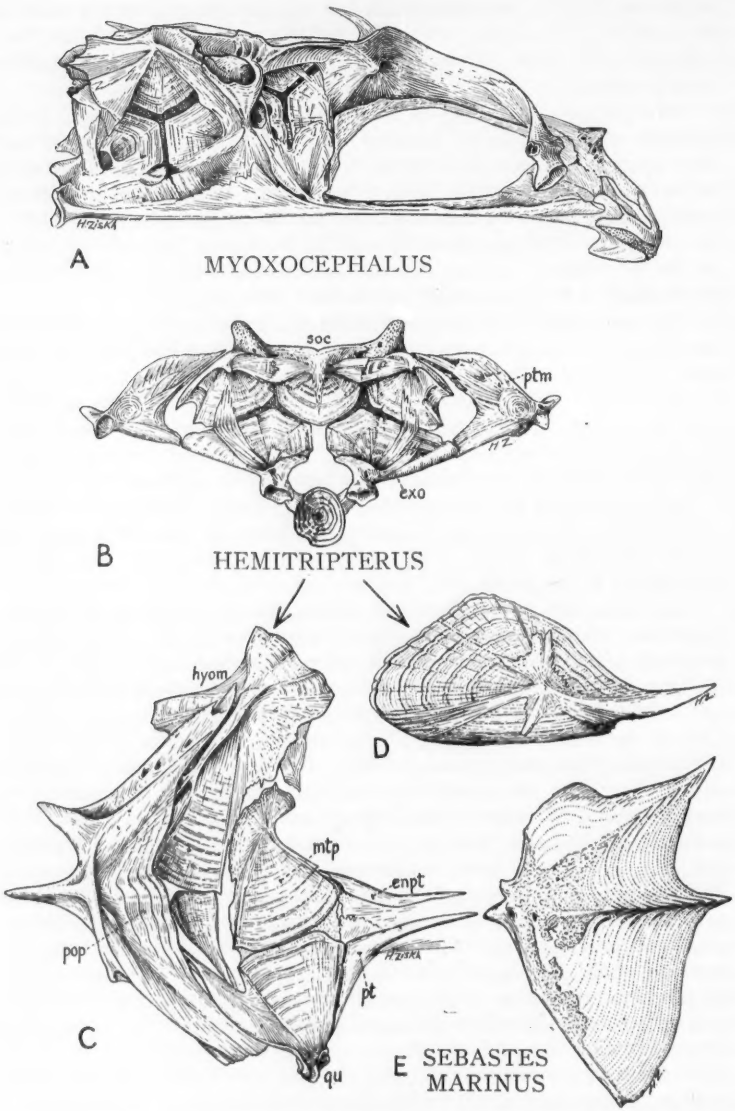


Fig. 1. Architecture of neurocranium and parts of the branchiocranium in the mail-cheeked fishes.

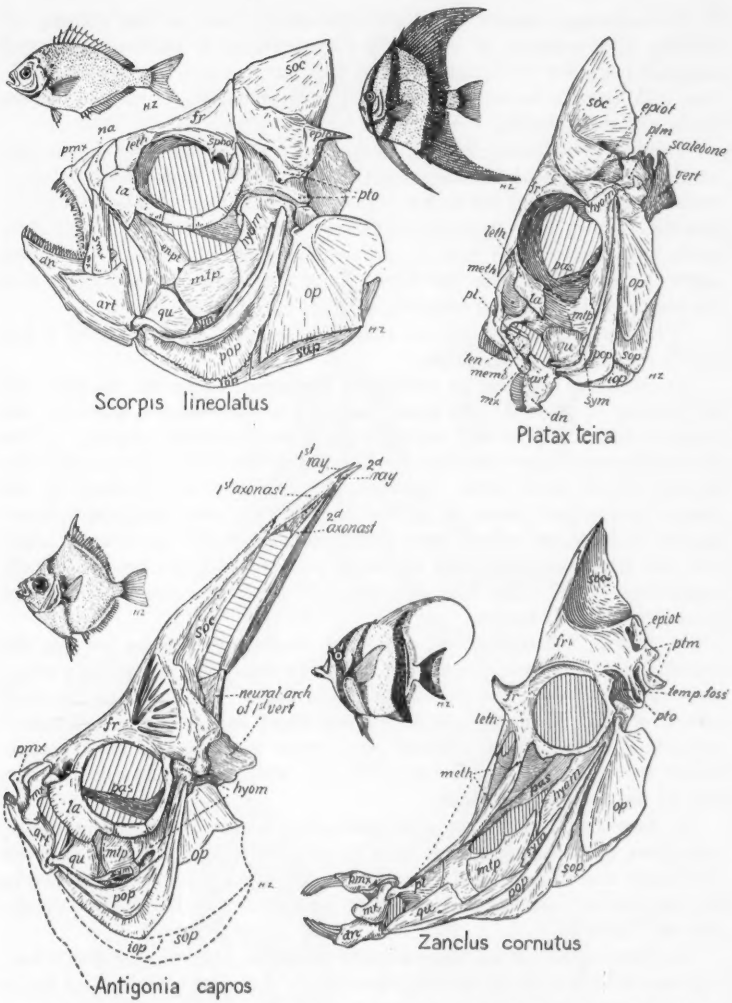


Fig. 2. Relations between skull-form and body-form in certain deep-bodied fishes.

in the enormous mouths and backwardly-slung jaws of the gulpers, especially *Gastrostomus,* in which the neurocranium is reduced to a small compact block for the support of this huge scoop-net. The opposite condition with extreme forward growth of the suspensorium is seen in the line leading to the balistids.

Passing to extrinsic factors, perhaps the most important factor that controls the height of the occiput is the height of the back. Embryological evidence shows that as the back muscles increase in depth the occiput grows upward. Hence very deep-bodied fishes (Fig. 2), such as *Platax, Antigonia* and *Zanclus* also have a very high occiput surmounted by a high sagittal crest. Hence also the slope of the skull roof varies directly with the height of the back and inversely with the length of the snout.

With such facts in mind, we may pass to the consideration of a few highly specialized teleost skulls.

In *Fistularia* we find an amazingly elongated, horizontal straight bill, terminating in an extremely small mouth. The mesethmoid, quadrate and preoperculum are produced forward to an unprecedented degree, so that the quadrate-articular joint lies far in front of the orbit. Presumably this mouth is used as a probe. Transitional conditions are afforded by the several species and genera of sticklebacks, the ordinary stickleback showing the initial stage leading away from a small-mouthed percomorph skull. The low back and long body of larval percomorphs has become greatly emphasized in this series. The pipe-fishes and sea-horses carry these strange specializations still further.

In *Platax, Chaetodipterus* and other deep-bodied forms we see the opposite specialization from the last, the body now being exceedingly short, high and compressed, the mid-facial region often very short and the skull excessively high at the occiput with a very short base. Such a deep-bodied series has probably been derived from more normal, moderately short-bodied forms resembling *Scorpis* (Fig. 2), which may stand near to the base of the percomorph series.

In these deep-bodied forms the jaws often become short and powerful, sometimes even beak-like, but there is no invariable correlation between jaw length and body length, since short, nipper-like jaws are developed in the long-bodied scarids and blennies as well as in the short-bodied ephippids and balistids.

In *Percis nebulosa* we have a fairly primitive percomorph which perhaps stands near to the base of the trachinoids and notothenioids. Its fairly long, low body may imply more or less retention of larval character.

In some long extinct form, perhaps not very different from *Percis,* we may seek the ancestor of the extraordinarily specialized dragonet (*Callionymus*). The general form of the body is elongate larval-like, hence the occiput is low. The large dorsally-placed eyes have greatly constricted the interorbital bridge and compressed the braincase in the fore-and-aft direction, somewhat as in *Astroscopus.* But the most extraordinary feature is the enormous pair of premaxillae which dominate the mouth and are received into a broad fossa of the ethmoid region. The preoperculum, unlike that of the vast majority of fishes, is directed sharply backward and

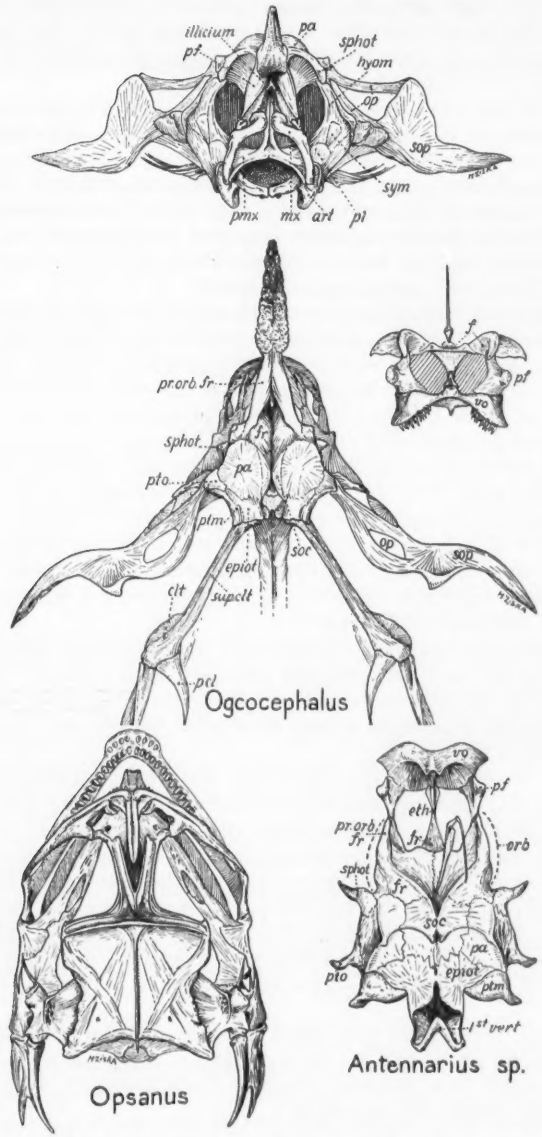


Fig. 3. Some strange adaptations in the skulls of *Opsanus, Antennarius* and *Ogcocephalus.*

bears several spikes, as in the strange *Gobiesox*. Perhaps the presence of more or less sucker-like pelvic fins immediately behind the base of the pectoral girdle may have influenced the dragging backward of the preoperculum, as it seems to have done in *Gobiesox*.

The skull top of the toad-fish (*Opsanus tau*) offers a surprisingly clear demonstration of the development of stiffening ridges and crests, apparently in response to stresses from the jaw muscles, transmitted through the hyomandibulars to the skull roof and interorbital bridge. Here is an elaborate system of inverted triangles with vertical and horizontal members, very much like an engineer's king-post arrangement. The toad-fish seems to stand near the base of the pediculate order, in which the skull exhibits diverse and bizarre specializations.

Among recent forms the least specialized skulls appear to be found in the division that includes *Antennarius* and *Histrio*. These fishes seem to have been derived from rock-dwelling, toad-fish-like forms with broad pectoral pterygials and a large mouth. The antennariids and their more primitive allies, the chirolophids, indicate that the next step was a marked expansion of the pharyngeal cavity by an initial stage in the transformation of one of the dorsal fin-rays into an illicium or lure. The top view of the *Antennarius* skull (Fig. 3) shows the illicium mounted on a basal rod, with its muscles occupying a broad fossa on the top of the skull. The mesethmoid has retreated to form the convex bottom of the fossa, while the raised orbital rims of the frontals project forward on either side of it. The *Lophius* skull appears to be an enormously widened and flattened derivative of an *Antennarius*-like type.

The typical ceratioids are secondarily free-swimming, toothed sacks, many of which have the pediculate pectorals much reduced. The illicial fossa extends widely, sometimes from the occiput to the broad snout. The opercular region, although greatly attenuated, retains the contacts and connections of *Antennarius*.

In the sea-bats (ogcocephalids) other new, strange specializations appear (Fig. 3). Starting from an *Antennarius*-like ancestor they adopted benthonic habits and emphasized their pediculate appendages. In *Ogcocephalus* the third dorsal fin-ray became hypertrophied into a horn-like process. This moved forward, dragging the preorbital processes of the frontal with it and overarching the small illicium. The latter with its fossa moved forward to the front of the skull, where it may still be found beneath this false rostrum. Meanwhile the suboperculum became enormously enlarged to give rise to the lateral margins of the expanded cephalic "shield" or disc.

By such methods we may partly decipher the history of specialized skulls even though we may not always be able to determine accurately their points of origin from different primitive stocks among the vast horde of percomorph families and suborders.

American Museum of Natural History, New York City.

A New Gonostomatid Fish, *Neophos nexilis*, from the Philippines

By George S. Myers

SOME time ago, among a collection of jars of miscellaneous old unidentified material in the Stanford Museum, I found a bottle containing a small gonostomatid fish unknown to me. I set the bottle aside intending to examine the fish but in the press of other work the matter was soon forgotten. Recently the receipt of Mr. Anton Bruun's paper on new gonostomatid fishes collected by the "Dana"[1] brought the little fish to mind and I looked up the bottle. A nearly effaced label reading "Philippines" is the only datum. The fish appears to belong to a genus and species, hitherto unknown, which I herewith describe.

***Neophos*, new genus**

Maurolicinae. Body elongate, compressed. Tail much longer than trunk. Dorsal short, its origin considerably behind that of the very long anal. Adipose absent. Pectorals well developed. Pelvics small. Mouth large, oblique. Premaxillaries, maxillaries, and mandible each with a single series of sharp conical teeth. A few conical teeth on palatines and on each side of vomer. Pseudo branchiae present. Gill-rakers well developed. Eyes large, not telescopic. Interorbital not very narrow. Photophores conspicuous. With the exception of a single organ above the pectoral base, the photophores of the trunk and tail are arranged in a single ventral series, those of the trunk in a close set row with a few breaks, those above the anal fin single and widely spaced. Closely allied to *Thorophos* Bruun but with the body more elongate, the dorsal shorter, the anal longer, the adipose absent, and the LO series of photophores reduced to one. Genotype the following species.

***Neophos nexilis*, new species**

Dorsal 8, last ray very slender. Anal 38. Pectoral 13. Pelvic 7. Caudal 10 above, 9 below, not counting accessory rays.

Measurements in millimeters (proportions of standard length in parentheses): Standard length 60. Head 11 (.18). Depth 10 (.17). Snout tip to dorsal origin 31 (.52). Head and trunk 24 (.40). Tail 36 (.60). Eye 4 (.07). Least depth caudal peduncle 4 (.07). Dorsal origin over ninth anal ray. Body deepest between pectoral and pelvic origins. Pectorals barely reaching pelvics. General appearance very similar to that of *Thorophos euryops* Bruun, but body more elongate.

Photophores: Orb 1; Op 1/1+1; SO 1; Br (6); IO 1+(2)+(3); BO (11); VO 1+(3)+1; AO 12 [13]; LO 1. The method for giving the formulae is that followed by Bruun, Jespersen, and Tåning.

Light brownish in alcohol, the eye dark. A few scattered chromatophores along back from head to dorsal and a scattering down the sides

[1] Vidensk. Medd. Dansk Naturh. Foren., 92, 1931: 285-291, pl. 8, fig. 1-3.

from a little before dorsal to caudal. Two brownish flecks at caudal base. Iris, suborbitals, opercles, and peritoneum silvery.

The single holotype is in the collection of Stanford University, No. 24798. Locality "Philippines." Other data lacking.

NATURAL HISTORY MUSEUM, STANFORD UNIVERSITY, CALIFORNIA.

A New Whitefish, *Prosopium snyderi*, from Crescent Lake, Washington

By GEORGE S. MYERS

IN 1892 Eigenmann and Eigenmann described *Coregonus coulterii,* a whitefish of small size, from the Kicking Horse River at Field, British Columbia. It was later figured by Eigenmann (1894, pl. 6). This species differs from all other known North American species in both its small size and its low scale count. It appears to be closely related to none. Since its original description it has been reported from Diamond Lake in northwestern Washington (Jordan and Snyder, 1909; Snyder, 1917) and from southwestern Alaska (Chignik River, Kendall, 1917; Lake Aleknagik, a tributary of the Nushagak River in the Bristol Bay region, Kendall, 1921).

Seven of the original types of *Coregonus coulterii* from Field are in the Stanford collection, as well as Snyder's three specimens from Diamond Lake. Besides these there is a fine series of 15 specimens, 99 to 144 mm. standard length, collected by Charles Petry in the Chignik River, August 1924; 2 specimens, 117 and 145 mm., from the Chignik River, collected by Harlan B. Holmes, June 11 to 19, 1928; and 4 small fish, 58 to 65 mm., collected in the Upper Chignik River, June 7 to 8, 1928, by H. B. Holmes. We thus have a good series of 31 specimens, practically representing the range of *coulterii* as it is now known, and including type material.

There is, in the Stanford collection, a single specimen of a whitefish from Crescent Lake, Washington, evidently related to *coulterii,* but differing so strikingly in a number of characters that I do not hesitate to describe it as new. With the fish is a note in the handwriting of the late Dr. C. H. Gilbert, indicating that he and Professor Snyder regarded it as probably representing an undescribed species. I follow Hubbs (1926, p. 12) in recognizing the genus *Prosopium* and refer to it both *coulterii* and the new form.

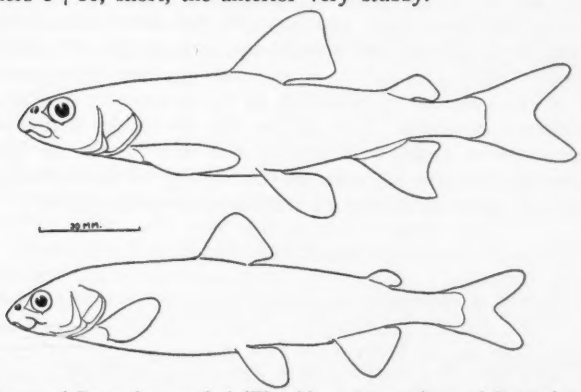
Prosopium **snyderi,** new species

In the long head, the high dorsal and anal, the long pectorals and pelvics, the very large adipose, the more compressed body, the very distinctive body and fin contours, and the low scale count, this species differs trenchantly from *coulterii.* It bears the lowest scale-count of any North American *Prosopium* and many characters indicate that it must take its place with *coulterii* as one of the two most distinct species in the genus.

Coregonus oregonius Jordan and Snyder (1909: 425) has a very large adipose fin but is otherwise not very closely related to *snyderi*. Incidentally, there appears to be no basis for the genus *Irillion* Jordan (Proc. Acad. Nat. Sci. Philadelphia, 1918 (Apr. 1919): 342), established for the sole reception of *oregonius*. This species, which is close to *williamsoni*, should be known as *Prosopium oregonium*, according to Dr. Hubbs, an opinion in which I concur.

Holotype No. 23751, Stanford University Fish Collection, from Crescent Lake, Olympic Peninsula, Washington, September, 1909, T. S. Potter.

Dorsal 11½, two undivided, the first very short. Anal 13½, three undivided, the first very short, the second a little longer. Pelvics 9. Pectorals 15. Caudal 19 fully developed rays. Lateral line 58+4 (+1 on opposite side). Transverse scales, dorsal origin to pelvic origin, 7/1/7. Gill-rakers 5+10, short, the anterior very stubby.



Holotype of *Prosopium snyderi* (Fig. A), and a specimen of *Prosopium coulterii* from Chignik River, Alaska (Fig. B). Drawn to the same scale by P. L. Bravo.

Body considerably compressed, more so than in *coulterii*. Head long, comparatively much longer than that of even young *coulterii*. Pectorals long, almost reaching pelvics, which in turn reach nearly to the anus. Adipose very large. Anal fin margin rather falcate, but possibly a little less so than represented in figure. Coloration pale, faded; no evident parr markings, such as those so prominent in our Chignik *coulterii*, are present.

Measurements in millimeters

Standard length, 137.0

Head length	34.0	Snout tip to occiput	25.0
Greatest body depth	29.0	Snout tip to dorsal fin	64.0
Least depth caudal peduncle	10.0	Snout tip to pelvic fin	70.0
Length caudal peduncle	21.0	Length dorsal fin base	17.0
Snout	9.0	Length anal fin base	17.0
Maxillary	7.5	Height dorsal fin	30.0
Diameter eye	8.5	Height anal fin	27.0
Interorbital width	7.5	Length pectoral fin	32.0
Depth head	21.0	Length pelvic fin	27.0

All the above measurements relating to fin position, head length, and the like are measured as to the vertical of the point indicated, along an ideal longitudinal axis of the fish.

In order to show more clearly the distinctive features of *snyderi,* I present an outline figure of the type together with one of a *coulterii* of approximately the same size from the Chignik River. Both outlines have been drawn to the same scale by Pablo Bravo.

Soon after I realized that this fish must be an unknown species, I spoke of the matter to Mr. L. P. Schultz of the University of Washington, and he promised to look for the fish on his next trip to Crescent Lake. Some time later he wrote me that inquiries made of old fishermen at the lake failed to elicit any information concerning the presence of whitefish. This in no way disproves their presence there. Conditions may be similar to those at Bear Lake, on the Utah-Idaho boundary, where whitefish were entirely unknown to the inhabitants about the lake until the advent of a fisherman, who, familiar with the whitefishes of the Great Lakes, put down gill-nets and brought up three species, all of them new (see Snyder 1919). Dr. Carl L. Hubbs tells me that there are repeated rumors of the presence of whitefish in the streams on the ocean side of the Olympic Peninsula. Is it possible that the species is *snyderi*?

I take especial pleasure in naming this new species for Professor John Otterbein Snyder of Stanford University, in appreciation of his numerous and accurate studies of western fresh-water fishes.

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Natural History Museum, Stanford University, California.

New Records of Marine West Coast Fishes

By Leonard P. Schultz, John Lawson Hart and Fred J. Gunderson

In the North Pacific Ocean, along the west coast of North America, a few species of fish have been taken so rarely in certain localities that it is deemed worth while to call attention to the following distributional records.

1. *Squatina californica* Ayres

The angel shark is a rare visitor north of California, but occasionally this species is taken north of its usual range. A specimen was reported (Evermann and Goldsborough, *Bull. U. S. Bur. Fish.*, 26, 1906 (1907): 222 and 228) from southeastern Alaska. Since *Squatina californica* has not been recorded from Puget Sound, the capture of a female, about 3½ feet long, near Seattle, on October 9, 1931, by William Jankus, may be of interest. This specimen is preserved in the Department of Fisheries Collection of Fishes, University of Washington.

2. *Acrotus willoughbyi* Bean

A specimen of the rag-fish *Acrotus willoughbyi* was caught by commercial fishermen at the surface of the sea near Petersburg, Alaska, during November, 1931, and was sent to the United States Bureau of Fisheries Laboratory, Seattle, for identification. Director Joseph A. Craig kindly gave the fish to the Department of Fisheries, University of Washington, to add to the rapidly growing Collection of Fishes started in 1928 by the senior author. This specimen, a male 5½ feet long, had greatly enlarged and probably mature testes. Its head was badly damaged. To our knowledge the capture of a rag-fish at Petersburg, Alaska, extends the range about 500 miles northward, while the southern limit was reported as San Pedro, California (Jordan, Evermann, and Clark, *Rept. U. S. Comm. Fish.*, 1928 (pt. 2), 1930: 269).

The rag-fish is a frequent visitor in Puget Sound, as numerous specimens have been reported from time to time (Crawford, *Copeia*, 160, 1927: 183). To these we may add a 6 foot specimen caught the first week in January, 1932, near Olympia, Washington. In the cold storage plant at the Spokane Street Dock, Seattle, may be found still another specimen taken a few years ago in the Sound.

3. *Sardinops caerulea* (Girard)

During the summer and autumn of 1931, pilchards penetrated farther to the north than has been recorded previously. Dr. George A. Rounsefell of the U. S. Bureau of Fisheries took more than twenty pilchards from several loads of herring caught on August 8 near Cape Ommaney in southeastern Alaska. That this record may indicate an actual extension of its range on the part of the pilchard is suggested by the unexpected abundance of pilchards on the usual British Columbia fishing grounds and the occurrence of pilchards in unprecedented quantities in the northern waters of British Columbia. We have records of pilchards being observed

in the estuary of the Naas at Kincolith, near the Wark Canal and in Steamer Passage. There are records of pilchards occurring in quantity during the summer at many other places on the Birtish Columbia coast, including: near the Skeena River, Cape St. James, Skincuttle Inlet, Gardener Canal, Smiths Inlet, Tribune Channel, Knight Inlet, Quathiaski and Pender Harbour. In a few of these localities pilchards had been observed before but never in the quantities reported last year. During the autumn and winter herring fishery in the Straits of Georgia, pilchards were taken much more commonly than usual among the herring.

4. *Cololabis saira* Brevoort

Three specimens of the Pacific saury were added to the Department of Fisheries Collection of Fishes in December and are reported here because they were caught about 175 miles to the northward of a previous record (Gilbert, *Proc. U. S. Nat. Mus.*, 48, 1914 (1915): 324), off the northwestern point of Vancouver Island, British Columbia.

TABLE I
COLOLABIS SAIRA BREVOORT
Measurements in hundredths of standard length

	Goose Island	— *Hecate Straits* —	
Length in millimeters	228	205	204
Length of head	21.9	23.4	22.5
Length of eye	3.5	4.1	3.8
Width of bony interorbital	4.0	4.1	4.1
Length of snout	8.7	8.7	8.8
Length of maxillary	5.2	5.6	5.3
Length of mandible	9.2	9.7	9.3
Length to anus	67.5	67.3	67.6
Depth of body	13.1	13.1	13.7
Width of body	7.9	6.5	7.8
Depth of caudal peduncle	2.2	2.4	2.4
Snout to dorsal	72.3	71.7	72.5
Length of dorsal base	9.2	9.7	9.3
Height of dorsal fin	6.1	6.3	5.9
Height of first dorsal finlet	3.1	3.4	3.4
Length of anal base	10.0	10.7	11.2
Height of first anal finlet	3.1	3.1	3.1
Length of pectoral	6.5	6.8	6.8
Ventral to anus	13.1	12.2	13.0
Length of ventral	6.5	6.3	6.3
Scale rows	120	129	121
Dorsal rays	11	11	11
Anal rays	13	14	13
Dorsal finlets	5	5	5
Anal finlets	6	6	5
Pectoral rays	13	13	13
Gill rakers on first gill arch	9+38	8+38	8+38

On the night of October 10, 1931, a specimen of *Cololabis saira* was washed through the scuppers on the deck of a halibut boat as it passed the southeast point of Goose Island, British Columbia. Two others were taken in a dip net by halibut fishermen: one at night during the last week of September, 1931, off Gander Island to Danger Rock, middle of Hecate Straits, the other one 21 miles east, off East Point of Moresby

Island, British Columbia, on October 25-27, 1931. These specimens were brought to the International Fisheries Commission, Seattle, and the Director of the latter organization kindly gave them to the Department of Fisheries, University of Washington. A careful study of these three specimens (cf. Table 1), indicates that they agree in detail with the description of *Cololabis saira* Brevoort and the measurements given by Hubbs (Hubbs, *Univ. Calif. Pub. Zool.,* 16 (3), 1916: 157).

Three other northern records of this species are of interest. Williamson (Williamson, *Mus. Art Notes,* 4 (3), 1929: 108) recorded the capture of one specimen in a pilchard seine off Nootka, Vancouver Island. This specimen was taken in July, 1929. We have another record for the species having been taken among a school of pilchards near Nootka on July 31, 1930. The remaining record is of a specimen found stranded on the beach at Port Hardy on the northeast coast of Vancouver Island about September 15, 1931. This specimen was sent in by Mr. Allan N. Lyon of that place.

Phillips (*Calif. Fish and Game,* 18, 1932: 23) reports an unusual abundance of this species at Monterey on September 15, 1931.

5. *Ulca marmorata* (Bean)

Two specimens of this cottoid were taken in a shrimp trawl at a depth of 15 to 20 fathoms near Wrangell, Alaska, by the junior author; one on September 12-19, 1931, and the other on December 1, 1931. To our knowledge this is a southern record, the range now extending from Bering Sea to southeastern Alaska.

6. *Pleuronichthys decurrens* Jordan and Gilbert

Two specimens of this flatfish have been added to the Collection of Fishes. One was taken in Zaikof Bay, Prince William Sound, Alaska, on November 30, 1928, by the International Fisheries Commission, and the other by the junior author in a shrimp trawl on December 1, 1931,

TABLE II
PLEURONICHTHYS DECURRENS JORDAN AND GILBERT
Measurements in hundredths of standard length

	Wrangell, Alaska	*Prince William Sound, Alaska*
Length in millimeters	207	37
Depth of body	64.7	54.3
Length of head	30.4	30.0
Upper orbit, longitudinal diameter	8.2	12.1
Distance across both orbits	12.3	17.5
Length of maxillary	7.2	6.7
Ventral of eyed side posterior to that of blind side	3.8	2.6
Length of caudal peduncle	9.6	6.7
Depth of caudal peduncle	14.0	13.5
Dorsal rays	70	76
Anal rays	47	48
Gill rakers on first arch	3+8	3+7

near Wrangell, Alaska. We identify these fish as *Pleuronichthys decurrens* after a careful study (cf. Table 2) and a comparison with the data given by Starks and Thompson (Starks and Thompson, *Proc. U. S. Nat. Mus.,*

38, 1910: 278). A few minor differences are evident, all of which may be attributed to age. Our specimens agree with the descriptions in regard to the occurrence of 9 rays on the blind side of the body and the origin of the dorsal well below the level of the snout. The range extends, therefore, from the Santa Barbara Islands to Prince William Sound, Alaska.

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Studies of the Fishes of the Order Cyprinodontes. XI. *Zoogoneticus zonistius*, a New Species from Colima, Mexico

By CARL L. HUBBS

THE rich collection of cyprinodont fishes in the Museum of Comparative Zoology includes some species which were indicated as new by the late Dr. Samuel Garman, who for some time before his death had in preparation a revision of his *Cyprinodontes* of 1895. Among these are two specimens from Colima, Mexico, collected by Gustav Glückert, and donated to the Museum on November 1, 1913. These represent, as Garman correctly appreciated, a very distinct species of *Zoogoneticus*. Permission to describe this species has graciously been extended by Dr. Thomas Barbour.

The genus *Zoogoneticus* has not been reported heretofore from outside the confines of the Rio Lerma drainage basin (including the Rio Santiago de Grande, under which name the lower course of the Lerma is known): the home of the entire family Goodeidae (see Hubbs, 1924a: 4). But two species of the family have been recorded from streams south of the Lerma basin. These are: (1) *Goodea whitei* Meek, of the Rio Balsas basin, made the type of a distinct genus *Balsadichthys* by Hubbs (1926: 19), and (2) *Characodon furcidens* Jordan and Gilbert. The latter is the only goodeid heretofore recorded from Colima. It also has been reported from the Rio Tuxpan[1] (Pellegrin, 1901: 122) and the Rio de Mascota (Regan, 1907: 90), both streams in Jalisco south of the mouth of the Rio Grande de Santiago, and on either side of Colima. *C. furcidens* has also been reported, no doubt erroneously, from "Cape San Lucas" (Hubbs, 1931: 2).

The only prior records of freshwater fishes from Colima of which I am aware are those given by Jordan and Gilbert (1882). In addition to the *Characodon*, these records are of three semi-fluviatile gobies: *Philypnus maculatus, Dormitator latifrons* and *Eleotris picta* (recorded

[1] Pellegrin gave this record as "de la rivière Tuxpan," "de l'Etat de Jalisco," presumably from the Tuxpan in Jalisco which lies east of Colima. Meek (1904: xxxvii and 122) apparently erroneously gave this record as for the "Rio San Pedro at Tuxpan, Jalisco." There is a Tuxpan on the Rio San Pedro (the name for the lower course of the Rio Mezquital), but it is in Tepic (=Nayarit), not Jalisco.

respectively as *Philypnus lateralis, Dormitator maculatus* and *Culius aequidens*). The known Colima freshwater fish fauna of five species is therefore 40 per cent of Rio Lerma, and 60 per cent of marine affinities.

The described species of *Zoogoneticus,* now regarded as valid, number four: *Z. robustus* (Bean), *Z. cuitzeoensis* (Bean), *Z. dugèsii* (Bean) and *Z. diazi* Meek. These are all diagnosed and figured by Meek (1904: 109-115, fig. 29-33), who, however, recognized three other species: *Z. pachycephalus* (Günther), which belongs in *Profundulus* Hubbs (1924b: 13), and *Z. maculatus* Regan and *Z. miniatus* Meek, now resting respectively in the synonymies of *Z. robustus* and *Z. diazi.* These species are now accepted as recognized by Regan (1907: 85-87).

Zoogoneticus **zonistius,** new species

Holotype: Cat. No. 32818, Museum of Comparative Zoology, an adult male 44 mm. long to caudal. Paratype: Cat. No. 97316, Museum of Zoology, University of Michigan, 48 mm. long.

Zoogoneticus zonistius, like each of the four other recognized species of the genus, is characterized by a strikingly distinctive color pattern. The most conspicuous features of *zonistius* are the five oblique ocellated bands on the posterobasal half of the dorsal fin, the jet black comma-shaped mark behind shoulder girdle and the intensely blackened scale borders on upper posterior sides.

In other respects than coloration, this species matches fairly well with *Z. robustus.* The scales appear to be a little smaller, in 40 instead of 36 to 39 rows. It appears to be most closely related to that species, which I interpret as the most primitive in the genus (and family). It is of interest that it approaches *robustus* most closely in distribution also, for *robustus* is the only species known to occur in the lower portion of the Rio Lerma, where the stream changes its name to Rio Santiago de Grande.

From *Z. cuitzeoensis,* the present species differs further in the much smaller size of the scales and in the much smaller eye. From *Z. dugèsii* it is readily set off by the finer scales, by the concave anterior profile, and the much more anteriorly placed dorsal and anal fins. From *Z. diazi* it is distinguished by the smaller scales, and by the more robust build, especially in having the caudal peduncle more than half as deep as the body, as in all the species other than *diazi.*

Description.—The body is heavy-set forward (the head two-thirds as wide as long); sharply compressed posteriorly. The greatest depth is contained 3.0 (3.3)[3] times in the standard length. The least depth is contained 1.8 (1.7) times in length of caudal peduncle, and 1.7 (1.6) times in head. The nuchal region is strongly humped, so that the profile near the occiput is distinctly concave. The edges of the caudal peduncle are nearly straight and parallel.

The head is widest through the turgid cheeks. The least width of the slightly convex interorbital enters the head 2.7 times. The orbit is not quite all included in the anterior half of the head; its length measures 4.3 (4.4) times in head. The jaws are equal; the upper lip anteriorly

[3] Parenthetic entries represent those measurements and counts of the paratype which differ from the corresponding ones of the holotype.

is on the same horizontal as the pupil. The mouth, more transverse than lateral, describes a very wide U-curve as seen from above; its horizontal lateral projection is only half that from tip of mandible to orbit; the width of the mouth, lips included, is just equal to the length of snout, being contained 3.25 (3.15) times in head; the length of the upper lip is about one-fourth its width. The teeth of the main row are strong, triangular incisors. Those of the narrow inner band are similar but much smaller. The gill-slit is restricted, as the opercular membrane is bound down: the slit continues straight upward and backward to less than half the pupillary diameter above the uppermost pectoral ray. The branchiostegals number 4 only, and the uppermost is expanded ventrally enough to be exposed between subopercle and interopercle. The gill membranes are broadly united and form a very narrow fold where united to the isthmus. The gill-rakers on the outer arch number 1+18, counting rudiments; all are shorter than the pupil. (The branchiostegal and gill-raker characters were determined on the paratype.)

Dorsal, 13; anal, 14; about 7 anterior anal rays shortened (both specimens are males); pectoral, about 21; pelvic, 6. The origin of the dorsal is midway between caudal base and upper edge of preopercular margin (or posterior edge of orbit); the length of the dorsal when depressed is contained 2.1 (1.9) times in distance forward to tip of muzzle; the highest ray measures 2.0 times in head, the base of the fin 1.5 times. The length of the stubby caudal fin enters 1.7 times in head. The highest anal ray enters the head 2.1 (2.0) times, the base of anal 2.2 (2.3) times. The length of the rounded pectoral, from upper angle, is two-thirds as long as head; the fin extends beyond vertical from pelvic origin a distance about 0.6 orbit. The rounded pelvics have their bases in contact, extend to the anus and enter the head 2.2 times.

Scales 16 or 17—40.

The sides (of the two alcohol specimens, both males) are purplish, except on the yellowish silver lower surface. The cheeks are golden, the opercles greenish, the top of head and muzzle purple. There are faint traces of vertical bars anteriorly and of an irregular median band posteriorly. There are some rounded dark spots above and behind pectoral bases, but these are not nearly so conspicuous as the somewhat scattered blackened scale borders on the upper two-thirds of the posterior two-thirds of the body. These markings, blackish purple, bave a rounded posterior and a straight anterior margin. The boldest marking on the body is the large jet-black comma-shaped mark extending from just behind the opercle, including its bound-down membrane, downward to behind the pectoral base, leaving a milk-white spot, in the angle of the comma, about the upper end of the pectoral base.

The dorsal fin is boldly marked by five black bands, bordered narrowly by whitish, and extending downward and backward across the posterobasal half of the squarish fin; elsewhere this fin is dark and indefinitely mottled. The caudal fin has a light yellowish crescent behind a diffuse dark basal blotch; behind the light bar the fin is abruptly darkened by black membranes. The other fins are somewhat dusky.

(*zonistius*, from ζώνη, zone, and ἱστίον, sail, referring to the black-banded dorsal fin.)

ERRATUM

To studies of the fishes of the order Cyprinodontes, X (Hubbs, 1931): Page 7, line 10: in place of *catenatus* read *confluentus*.

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Adaptive Convergence in the Sand Reptiles of the Sahara and of California: A Study in Structure and Behavior

By Walter Mosauer

THERE exist in literature many short remarks concerning the desert adaptations of reptiles, but an extensive comparative study, linking up structure and habits, remains to be made. Continuing work begun on the Sahara in 1926 and 1928, the writer is at present carrying on an investigation of this nature. The similarities found between Saharan and American forms are amazing.

From the first it is necessary to clearly differentiate between the adaptations of animals to desert conditions and their adaptations to the sand. The former enable the animal to exist under the severe climatic conditions of the desert; these adaptations seem to be "found rather in their behavior than in their structure" (Kashkarov and Kurbatov, 1930). Very distinct, however, are the structural changes that the mechanical features of the sand, the texture of the substratum, have brought about. Sand reptiles are not necessarily desert reptiles—as an example may be cited the hog-nosed snake, *Heterodon,* which possesses a very highly specialized digging snout, but does not live in desert regions.

The structural changes involved are twofold: there are modifications present facilitating locomotion on or in the sand, while others serve for protection of the sense organs and body openings. The specializations of the locomotor apparatus involve body form as well as the shape of the head and the structure of the extremities. They differ widely with the habits of the animal. There are cursorial species, many of which travel at extraordinary speed over the surface, and which are also able to burrow. They do not, however, proceed beneath the surface of the sand for any considerable horizontal distance. Some of them sink into the sand in a vertical direction, so that they are found beneath the spot where they left the surface.

Other sand reptiles live *in* the sand as truly subterranean forms. They differ in their adaptations so highly from the burrowers in firm soil that the writer proposes to apply the term "subarenaceous" to them to distinguish them from subterranean forms. A continuous series of intergradations connects the extremes of the cursorial and the burrowing type, while some structural features may be in common even to these widely distant ends of the chain.

Most typical cursorial species have a rather slim body with elongated extremities in lizards, a slender body with long, tapering tail in Colubridae (*Psammophis*). An excellent example for the former is *Callisaurus ventralis,* with its almost grotesquely long legs, feet and toes. Although *Callisaurus* is by no means restricted to a sandy habitat, it shows adaptations to it, as can be seen from the shape of the snout, to be described

later. The elongation of the extremities distributes the weight of the animal over a greater area, thus preventing it from sinking into the loose sand. This increase of the area resting upon the substratum is also attained by other means. The most common of these is the development of fringes on the toes. This is to be found in the most typical of all American sand lizards, *Uma notata,* in *Callisaurus crinitus,* in the African forms *Acanthodactylus* and *Scincus,* in the Asiatic *Teratoscincus, Phrynocephalus,* and many others. In some of these the fringes serve not only for prevention of sinking in while the animal is running on the surface, but also for greater efficiency in digging. The latter may be the main function in forms like *Scincus* that spend much of their time beneath the surface. These lizards have not only the toes of the hind feet, but also those of the fore feet fringed, since the fore feet play an important role in digging. Then the latter are relatively large, the fore legs strong; while the fastest cursorial types in contrast show a marked tendency to dispense with the services of the anterior extremities. This is carried to the extreme in African and Amercan desert mammals, the kangaroo rats (*Dipodomys*) in this country, the "jerboas" (*Dipus*) in the Sahara. Desert reptiles have not gone so far, yet bipedal locomotion is common among the lizards, used at top speed only. The tracks in the sand, from which one can gain considerable information concerning locomotion, show clearly the great difference in the work done by fore and hind feet. This difference is accentuated as the animal accelerates until the fore feet are raised off the ground entirely and are pressed to the body. This seems to be advantageous for very rapid movement. Apparently for similar reasons the tail, which generally drags in the sand at a slow pace, is raised off the ground (as in the African *Acanthodactylus,* the American *Cnemidophorus, Uma, Dipsosaurus,* and others), or even curled high up over the back, as in *Callisaurus.*

One of the most amazing convergences in Saharan and California sand reptiles is the similarity in locomotion of the African sand vipers *Cerastes cornuta* and *Cerastes vipera* on one hand and the sidewinder, *Crotalus cerastes,* on the other. Without going into detail it may be said that this sidewinding locomotion applies the principle of a spiral or helix, rolling sidewise. Thus it has the mechanical advantage of not requiring the reactions of lateral firm points of resistance against the forces applied to them, which is the foundation of the horizontal undulatory movement used by most snakes. In sidewinding, the substratum simply has to bear the vertical pressure of the weight of the snake, resting on the two sections touching the ground, but no reactions of the substratum are necessary for progression. Similar as *Cerastes* and *Crotalus cerastes* are in locomotion over the sand, they differ in their ability to bury themselves in the sand, as will soon be seen.

Most of the cursorial species are able to hide themselves under the sand. It is a typical feature of the loose texture of this substratum, that permanent burrows are difficult to maintain, because the sand caves in so easily, obliterating any hole. Thus the reptiles of the region cannot dig themselves a permanent refuge, into the air space of which they could

retreat for protection from the daily temperature extremes. Yet this protection is needed by nocturnal snakes like *Cerastes* and *Crotalus* from the burning sun rays, and by lizards from the cold of the desert night. They are forced, therefore, to bury themselves every time anew, usually in new spots unless they use the holes of more efficient burrowers like rodents. This burying may be done in a vertical direction, so that the animal is found just beneath the spot from where it disappeared. It is accomplished by sidewise shaking movements of the reptile.

The best example for this is to be seen in *Cerastes*. While lying in the shape of a sinuous curve with closely drawn bends, the snake starts the digging at a point near the posterior end. The movement consists of a transverse shaking, which proceeds from the tail headwards, without change in the position of the main bends of the body. The very slight sidewise movement of each point is aided by the movement of the ribs, which are spread alternately on both sides. Thereby they form a sharp keel along the side that cuts like a shovel into the sand and throws it upon the dorsal surface of the snake. Thus the animal disappears rapidly from the surface, the points covered by sand coming to rest while other portions nearer the head start moving. Finally, the head also is subjected to the transverse movement, covering it with sand. The snake never proceeds beneath the surface of the loose sand, a fact that is structurally obvious: there is no indication of a digging snout, and the scales are heavily keeled, so that the snake has a rugged appearance.

Crotalus cerastes lacks this ability of burying itself. When found in day time, the sidewinder is usually coiled in a very typical manner, forming a spiral, the head in the center resting on a section of the body. The snake as a whole projects slightly above the level of the sand, but there is a sand wall surrounding the periphery of the circle formed by the snake's coils. This sand wall is a result of the peculiar manner in which the snake draws in its posterior portion after the more central coils have settled. There is also a slight indication of the rib movement as described for *Cerastes,* in which here only the peripheral coil of the spiral participates. To protect itself from the desert sun, the sidewinder usually selects the shady side of the small hills or bushes for rest during the day. Burrows of kangaroo rats are also used as refuges, as observed by the writer. It seems strange that the sidewinder, although showing the same type of locomotion as *Cerastes,* has not evolved a digging habit similar to that of the latter.

A number of lizards appear to be intermediate in their digging habits between the extremes of sinking in on the spot and of travelling extensively beneath the surface. An example for these are the horned lizards (*Phrynosoma*) which bury themselves, as Weese describes: "The snout is directed downward and moved from side to side, the body extremely flattened, while the legs take part in a rapid horizontally clawing movement." This movement is aided by lateral vibrations of the posterior portion of the lizard's body extending to the tip of the tail. Simultaneously, however, the animal pushes itself forward, so that it comes to rest slightly ahead of the spot where the digging action had started.

In most lizards, in which the burying is partly or wholly accomplished by lateral shaking movements, the body and tail are found to be flattened dorsoventrally. A dermal fold may be present along the sides of the body, or series of spine-like scales form fringes along body and tail. The depressed shape of the tail of *Uma* has recently been remarked upon by Burt (COPEIA, 1931). Contrary to his opinion, however, the tail cannot be flattened actively or passively, but always retains its peculiar shape. This is due to the great elongation of the transverse processes on the anterior caudal vertebrae. In *Cerastes* the extremely coarse keels of the scales supplant the dermal folds and lateral fringes. These keels are present even on the lowest, usually unkeeled, scale rows, which are peculiarly oblique in position. The snake as a whole appears extraordinarily rugged, a structural feature that seems to facilitate the digging by lateral shaking.

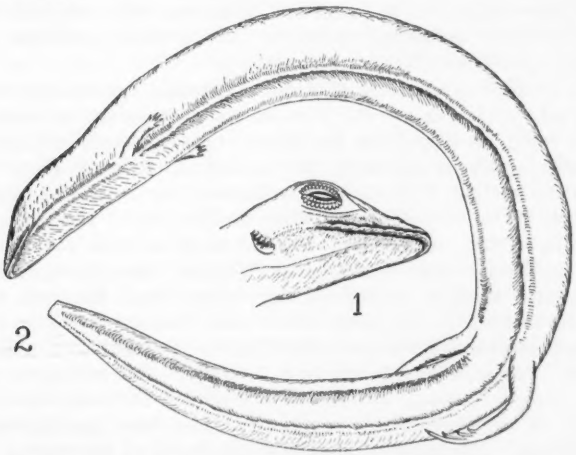

Fig. 1.—Diagrammatic drawing of the head of *Uma notata*, showing the *canthus rostralis*, the countersunk lower jaw, the peculiar eyelids and the scales overlapping the ear opening.

Fig. 2.—Diagrammatic drawing of *Chalcides sepoides* as representative of subarenaceous reptiles, showing the "streamlined" head and body, the sharp *canthus rostralis*, the countersunk lower jaw, and the slightly concave ventral surface.

In *Uma notata* the forward component of the burying action exceeds and obscures the lateral shaking which is most obvious in the vibrations of the tail. *Uma* sometimes proceeds beneath the sand for a distance several times its own length. The structural adaptations of this species (Fig. 1) are correspondingly more closely related to those of the true subarenaceous forms. The scales of the body are reduced to granules, giving a velvety effect. This lessens the friction in the sand as compared with the rough scaled forms mentioned above. The most significant similarity to true subarenaceous species, however, is found in the structure of the snout. The rostral and the upper labials form a projecting

sharp edge, the *canthus rostralis.* This edge divides the surface of each labial shield into an upper part, facing up and sidewise, and a lower part, facing downward. The lower jaw, considerably less in circumference, fits into the frame provided by the upper row of labials, so that the lower labials are at approximately the same level as the lower surface of the upper labials. Thus the lower jaw is concealed in profile view, *countersunk* into the upper, forming with it a continuous level surface. This has, of course, the significance of eliminating any resistance that would be offered by a protruding lower jaw; at the same time, it protects the mouth opening from being forcibly opened when the animal violently pushes its head into or through the sand. This structural feature strongly reminds one of the similar arrangement of the mouth opening in the fast swimming sharks. In fact, the loose texture of the sand renders it mechanically similar to a fluid medium. The countersunk lower jaw is, to some lesser extent, to be found in *Callisaurus,* while not even in *Uma* is it as perfectly developed as in the subarenaceous African forms, *Chalcides sepoides* and *Scincus.*

Both of these skinks were observed in the field and in captivity for a long period. *Chalcides sepoides* lives beneath the surface for most of the time, as could be seen from the typical tracks in the field and from actual observation in captivity. In its "submarine" ramblings it stays close to the surface, "swimming" in the sand by horizontal undulatory movements of its very elongated body and tail, while the vestigial legs seem to be of little or no use. Thus it leaves a track consisting of a groove, regularly sinuous in shape, paralleled on both sides by sand walls. This peculiar track is formed by the caving in of the sand covering the lizard as soon as the latter moves on. The structural peculiarities of the species (Fig. 2) are perfectly fitted for the mode of life described. The head is as wide as the neck and the body. The top of the head is smooth, slightly rounded, without any projections—"stream lined"—separated by an extremely sharp *canthus rostralis* from an absolutely flat lower surface. The latter is formed by the frame of the rostral and the upper labials, into which the lower jaw is countersunk.

The slender body is covered by smooth, highly polished scales, which render the animal shiny like mother of pearl, and reduce friction in the sand to the possible minimum. The ventral surface of the body and tail is concave, bounded from the flanks on each side by a keel which starts on the lower jaw as a rounded edge, continues along the neck to the base of the fore limb and behind the latter as a sharper edge along the trunk to the base of the hind limb. Thus the lower surface of the skink, starting at the flat gular region, has the shape of a longitudinal shallow trough. The same peculiarity exists in *Scincus officinalis,* which also is mainly subarenaceous. The closely related *Chalcides ocellatus,* however, which represents the genus in the oasis a hundred yards from the sandy habitat of *C. sepoides,* has not only a rounded snout with an unmodified lower jaw, but also a cylindrical body. Thus it seems reasonable to assume that the crescentic cross section of the body of the subarenaceous forms has a mechanical significance in burrowing, functioning as a double keel

and thus preventing slippage in the horizontal undulations of the body.

The Californian reptile that seems most similar in structure and habits to *C. sepoides* is not a lizard, but the small snake *Sonora occipitalis.* This snake travels only over short stretches on the surface and spends most of its time in the sand. It proceeds beneath the sand by means of the same horizontal undulatory movement by which *C. sepoides* moves, and which the snake also applies for locomotion on the surface. Both reptiles have in common the swift, smooth mode of slipping into the sand, disappearing from sight in an incredibly short time.

Structurally their heads are very similar; the *canthus rostralis,* however, is not as sharp in the snake as in the skink, although the lower jaw is as perfectly countersunk. Similar also is the small size of the head, which in the *Sonora* is narrower than the body at its greatest width. The latter is covered with large, smooth, polished scales. Although a concave ventral surface is not noticeable in *Sonora* when handled, it is present during locomotion on or in sand. Apparently the ventral scales are drawn in through action of the abdominal muscles and the lower ends of the ribs project forming sharp keels. This was observed from below on specimens moving on a glass plate.

Another Californian sand inhabiting reptile is the footless lizard, *Anniella.* In its structural characters it agrees quite well with the description of the other forms of similar habitat except for the fact that the *canthus rostralis* is not well developed. The head of *Anniella* is more rounded; it remains to be seen, whether or not this lizard inhabits relatively firm soil also. Burt (Copeia, 1931) suggested that the usual habitat was to be found in *moist* sand, which of course is much less loose than dry sand and corresponds in its mechanical features rather to firm soil. Klauber (Copeia, 1932) points out, however, that "the presence of this lizard is definitely established in desert situations." Preserved specimens show a concave lower surface.

The structural adaptations of typical subarenaceous reptiles differ distinctly from those of subterranean forms living in firm soil. In the latter we find blunt, rounded heads with very solidified skulls, that can withstand the pressure exerted on them by the firm medium. The sharp, keeled wedge-like heads of subarenaceous reptiles are suited for the loose sand only, which mechanically resembles a fluid medium.

Another category of adaptations to a sandy environment is not concerned with locomotion but with protection of the body openings. The placement of the mouth opening on the lower surface, as found in *Callisaurus, Uma, Chalcides sepoides, Scincus* and *Sonora* has been mentioned above. The nostrils, curiously enough, do not show any apparent special adaptation in most cases. Neither their location nor their size or structure indicate any particular protective measures against the sand—not even in the most highly modified Scincidae. Only *Phyllorhynchus* possesses crescentic, slit-like nostrils, overlapped by the sharp edge of the nasal scales through which they cut obliquely. Quite different is the amount of protection given to the external acoustic meatus. Practically all sand lizards agree in having the ear opening either obliterated,

the tympanic membrane being covered by small scales, or overlapped by large scales projecting from the anterior margin of the opening. The former type is to be found in *Phrynosoma platyrhinos* and *P. m'callii,* also in *Holbrookia,* the latter in *Uma* as well as in a number of exotic forms. In *Chalcides sepoides* large, flat scales overlap the ear opening so as to practically close it, yet they do not attach posteriorly, leaving a capillary slit.

The eyes are protected by a special development of the lids which are very thick and beset with fringe-like scales. The lids close with a double surface, a narrower inner surface, the true *canthus,* and an external, wider surface. Upper and lower lid come into contact first with their inner surfaces, their outer surfaces touch each other fully when the lids are firmly closed. In *Uma* these features are especially clearly developed.

Generally speaking, the adaptations of sand inhabiting reptiles to the mechanical features of their environment are very distinct. Certain habits of locomotion and digging are correlated with certain structural peculiarities; thus cursorial forms that live mainly on the surface are quite different from others, termed "subarenaceous" which swim in the sand as in a fluid medium. The adaptations for protection of the body openings, although sometimes quite distinct, appear less convincing.

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Bidder's Organ in *Bufo melanostictus* Schneider

By Gordon Alexander

BIDDER'S organ, characteristic of toads, appears histologically to have a structure very similar to that of the ovary. Experimentally, it has been demonstrated to have the potentialities of an ovary. (See Harms, 1926, and references given by him.) The removal of the testes in males may result in the hypertrophy of these organs, with the attainment of the structure and function of typical female gonads. In fact, we have here one of the best known cases of so-called sex-reversal in the animal kingdom. For this reason, Bidder's organ has come in for an enormous amount of attention in recent years, particularly in experimentation.

That this organ is not an hermaphroditic gland is indicated by its cytology, as well as by the fact that it is apparently not potentially a testis in the female. Actually it has a tendency to completely disappear in females, and it is much rarer in mature females than in mature males.

Rau and Gatenby, in 1923, summarized the information available to them at that time on the occurrence and distribution of the organ of Bidder, particularly in several species of *Bufo* in which it had not been previously studied. They found, that in *Bufo melanostictus* Schneider, the organ was present in all males which they examined; but they could not find it in mature females. A figure is given by them of the organ in a male of 58 mm. body length. The number of specimens available to

Rau and Gatenby is not definitely stated, but the number implied in their account is small. The purpose of the present account is to point out the fact that Bidder's organ does occasionally occur in mature females of this species.

My own conclusions are based on the examination of 68 fresh specimens of this toad, all specimens collected at Bangkok, Siam, between October, 1928, and May, 1930. Of these, 41 were females, and the other 27 were males. All of these were of comparatively large size: only the largest individuals from each collection were used,—an average of about seventy-five per cent of each collection being released. The females examined ranged in weight from 32 to 140 grams, and in length (tip of snout to vent) from 68 to 108 mm.; the males were between 30 and 95 grams in weight, and 65 and 92 mm. in length. The difference in the maxima are, of course, significant evidence of the greater average size of the females.

The smallest female with a fully developed ovary weighed 48.3 grams. The ovary in this specimen weighed 8.7 grams. This female was indisputably mature. Of the 41 females studied, 33 weighed as much or more. For the purposes of this analysis I have considered all these individuals mature. It may be argued that some females in this group were not actually mature, and that the only true criterion of maturity is ovary appearance. But some of these specimens were probably collected shortly after spawning, at which time the ovary would appear immature. This is indicated by the fact that some females with very small ovaries were, nevertheless, very large animals.

Of the 33 individuals in the above category, 8 definitely possessed Bidder's organ, and in one other its absence could not be definitely determined. In the other 24, the structure was almost certainly absent. In general, this structure was apparent in specimens with small or reduced ovaries, and absent or concealed in those with large ovaries. If this observation indicates a general condition, it may be explained in terms of a cyclical change comparable with Harm's (1926) findings for *Bufo vulgaris*. In plotting the seasonal changes in size, he indicated that Bidder's organ is so small as almost to disappear between the months of September and March, and that it is largest during the breeding season. It is possible, therefore, that this structure was overlooked in some fe-

DATA CONCERNING MATURE FEMALES POSSESSING BIDDER'S ORGAN

Serial Number	Date Collected	Weight in gms.	Length in mm.	Ovary weight in gms.	Ovary weight per cent of total weight
29	June 20, 1929	71.8	98	0.8	1.1%
32	July 6, 1929	94.3	95	3.1	3.3%
49	December 11, 1929	85.1	95	0.9	1.0%
52	January 24, 1930	98.3	103	2.1	2.1%
54	January 24, 1930	86.8	95	2.2	2.5%
63	May 10, 1930	61.0	85	0.4	0.7%
65	May 12, 1930	50.9	82	0.6	1.2%
67	May 12, 1930	49.3	76	0.5	1.0%

males with large ovaries. It was probably completely absent in many individual females, however.[1]

I have no record of Bidder's organ in one male, one of the first specimens studied, and one for which the records are incomplete. In all other males examined this organ was present. It may be considered normally present in all males of this species; but, although present in some mature females, it is probably absent in the majority of individuals of that sex.

The typical appearance of Bidder's organ in males and females of *Bufo melanostictus* is illustrated in Figures 1 and 2, respectively. These figures were drawn to scale, with dividers, from fresh specimens. Fig. 1 is from a male collected May 10, 1930, weighing 95 grams,—the largest male collected; Fig. 2 is from a female collected July 6, 1929, weighing 94.3 grams. This female had the largest ovary of any of the females possessing Bidder's organ.

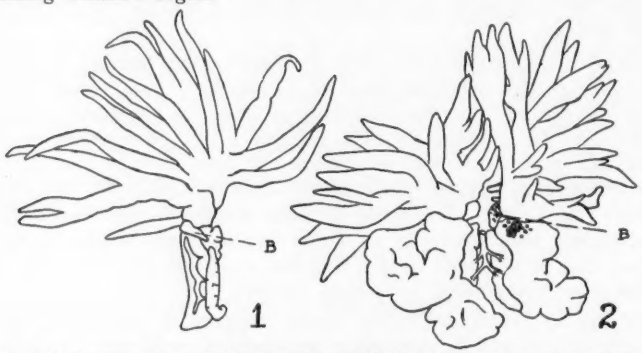

Fig. 1.—Right mesonephros, fat-body, testis and Bidder's organ (B) of a mature male *Bufo melanostictus*. Two-thirds natural size.
Fig. 2.—Ovaries, mesonephroi, fat-bodies and organs of Bidder (B) of a mature female *Bufo melanostictus*. Two-thirds natural size.

Certain data from the male figured here may be of interest. The right testis weighed 0.0736 grams, the right Bidder's organ, 0.0192 grams. These weights were determined on a balance accurate to one-tenth milligram, but, since the organs can not be delimited with such accuracy, the determinations cannot be considered accurate to the last decimal place. Calculations of volume, necessarily still more inaccurate, indicate that the density of the Bidder's organ in this specimen was about thirty per cent greater than that of the testis. Further data on the mature females possessing Bidder's organ is given in the accompanying table.

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[1] Breeding individuals of Bufo melanostictus may be found at Bangkok during almost any month of the year. Cyclical changes correlated with a short breeding season are, therefore, not to be looked for. A report on the degree of seasonal variation in this form is now being prepared for publication.

The Identity and Status of *Pseudotriton duryi*

By CHARLES F. WALKER and W. HAMILTON WELLER[1]

THE salamander from northeastern Kentucky recently described by the junior author (Weller, 1930) as *Pseudotriton duryi* is, in fact, referable to the genus *Gyrinophilus*. Specimens of this salamander were taken by the writers independently, Walker collecting in southern Ohio and Weller in Kentucky. The purple salamanders of this region are readily distinguishable from either *Gyrinophilus porphyriticus* or *G. danielsi* although intermediate in some respects between these two. Since the original description of *duryi,* in which it is compared with the more distantly related *Pseudotriton montanus,* is not entirely adequate to distinguish the new form from its congeners, it has seemed advisable to present a more detailed account. From the original cotypes we here designate as holotype the specimen formerly catalogued as 499d in the collection of the Cincinnati Society of Natural History, now No. 84300 in the United States National Museum collection.

This specimen is an adult female from "Cascade Caves, near Grayson, Carter County, Kentucky, April 6, 1930." Costal grooves 18; 7 intercostal folds between the toes of the appressed limbs; head width 7.6 in length from snout to posterior angle of vent; head length 5.1 in length from snout to posterior angle of vent; a distinct canthus rostralis; snout truncate; eye as long as its distance from nostril; a small tubercle on edge of upper lip below nostril; a strong gular fold extending up on sides of head; a weak groove immediately posterior to angle of jaws, crossed by a groove extending posteriorly from eye; fingers 3, 2, 4, 1 in order of length; toes 4, 3, 2, 5, 1 in order of length; tail shorter than body (tip missing), with well developed dorsal fin; vomerine tooth rows continuous with parasphenoids; vomerine branches extending laterally to slightly beyond outer margins of nares; parasphenoid rows separated anteriorly by a distance less than their width, diverging posteriorly; tongue with central stalk and free margins; color dull salmon above, white below; sides of body and tail with numerous, small, black spots, generally rounded in shape; dorsum sparsely spotted; a few spots on head and limbs; a light line along canthus; a few scattered flecks of black on gular region and throat; margin of lower jaw with black spots; total length 157 mm.; snout to posterior angle of vent 96; length of head 18.5; width of head 12.5.

In addition to the type, twenty-five other metamorphosed specimens of *duryi* have been examined, eleven of these being topotypes from the collection of the Cincinnati Society of Natural History. The Ohio State Museum has specimens from Scioto, Adams, Pike and Highland counties, in southern Ohio.[2] These specimens agree with the type in the presence of distinct black spots on a dull salmon ground color, and in the possession

[1] These notes were prepared by the writers in June, 1931, only a few days before the tragic accident in which Mr. Weller lost his life. Subsequently it was necessary to make a few minor changes and the final draft of the manuscript was never seen by Weller.—C. F. W.

[2] Three old specimens from Hamilton County, Ohio (C. S. N. H. 66-68) are probably also referable to duryi but have been disregarded here due to their poor state of preservation.

of white venters. There is no black line below the canthus rostralis as in *danielsi*. Our series shows much individual variation in the degree of spotting. Small specimens are usually less spotted than large ones; a young individual from Scioto County, Ohio, has only eight spots on one side and ten on the other, these at the level of the limbs, while a large topotype (C. S. N. H. 449e) is as heavily spotted as some individuals of *danielsi*. However, the spots in *duryi* are always most numerous on the sides, and often entirely absent from the center of the dorsum. None of the series shows the heavy markings on the throat found in many large specimens of *danielsi* from the southern mountains. The ground color in small specimens of *duryi* is a clear, dull salmon; in large specimens it becomes dusky but lacks the mottling of *porphyriticus*. The width of the head is contained in the body length from 7.1 to 8.4 times. There are either 17 or 18 costal grooves and the toes of the appressed limbs fail to meet by from 5.5 to 8 intercostal folds. The parasphenoid tooth rows may be contiguous anteriorly but more often are narrowly separated, and the vomerine rows extend to the outer margins of the nares or slightly beyond.

The larvae of *duryi* are very pale; a dusky reticulate pattern is present as in larval *porphyriticus* but is often obscure. In a few large specimens the adult pattern is represented by poorly defined dots but more often it seems that the spots are scarcely distinct until metamorphosis. According to Bishop (1924: 91) the spotting of *danielsi* is present in small larvae.

To sum up the distinguishing characters: *duryi* differs from *porphyriticus* in the presence of distinct black spots and in the lighter color of the upper parts; from *danielsi* in the lateral concentration of the spots, the absence of a black line along the canthus, and, when large specimens are compared, in the narrower head. A further distinction between the two spotted forms, possibly of considerable significance, is seen in the ventral coloration, which is always white in *duryi*. Contrary to any description that we have seen, our fourteen specimens of *danielsi* had red venters. This color was apparent only in the living and freshly preserved specimens. Variations in the degree of spotting of *danielsi* such as have been pointed out by Bishop (1924: 90) are apparent in our small series, but there is no approach to *duryi* in any of the characters given above.

The present material has been inadequate to determine satisfactorily the relations of *duryi* with the other forms. There is some evidence of intergradation with *porphyriticus*. Thus a purple salamander from Washington County, Ohio (O. S. M. 711), has poorly defined dark spots along the sides while the upper surface is mottled as in *porphyriticus*. A larger *Gyrinophilus* from the same region, in the Marietta College collection, is very dark and shows no spots. *G. porphyriticus* occurs both to the north and to the south of the known range of *duryi*. There are a number of specimens in the Ohio State Museum from Hocking County and northwards, and Dunn (1926: 265-266) gives records from Kentucky, West Virginia and Tennessee. The Estill County, Kentucky, record is especially noteworthy since it seems to lie between the ranges of the two spotted forms. The specimen on which this record is based (U. S. N. M. 57357) has been examined. It is a small female, 106 mm. in length, and seems

to be a typical *porphyriticus,* having the dorsum clouded with diffuse black pigment and lacking spots. The nearest locality for *Gyrinophilus danielsi* is furnished by a specimen (C. S. N. H. 682) from southeastern Bell County, Kentucky, near Cumberland Gap, taken May 25, 1930, by Mr. Ralph Dury. This record extends the range of *danielsi* considerably to the north.

It seems not improbable, as Dr. Dunn has suggested in correspondence, that all three of these forms will eventually be considered races of one species. However, in our present material there is only one specimen which seems clearly to represent intergradation between *porphyriticus* and *duryi,* and none which connects *danielsi* with either of the other forms. Unfortunately many records in critical localities are based upon larvae or poorly preserved adults.

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Ohio State Museum, Columbus, Ohio, and
Cincinnati Society of Natural History, Cincinnati, Ohio.

The Food and Feeding Habits of Some Eastern Salamanders

By William J. Hamilton, Jr.

THE following observations have been made within a few miles of Ithaca, New York. The specimens of *Necturus* have come from Cayuga Lake and its inlet; the smaller salamanders from the many streams and ponds that are common to this region. The percentage-by-bulk method has been employed to determine the relative amounts of the various food items. In all instances where practical, field observations of feeding animals have supplemented laboratory studies, in an endeavor to find out if any predilection is shown certain food items where a wide choice occurs. While observations upon feeding newts are readily made, such is not the case with mudpuppies and the smaller secretive plethodonts. This study has been carried on since the spring of 1925 until the present time.

1. *Necturus maculosus* (Rafinesque)

Of nearly 500 stomachs examined, 340 contained food. The following numbers indicate percentage by bulk: crustaceans, 32.7; insects, 30.1; fish, 13.2; annelids, 11; molluscs, 5.2; amphibians, 4.1; inorganic, 3.3; and a trace of vegetation in several stomachs. Since the individuals studied have been taken at various times of the year, including winter, the results indi-

cate a fair index of the choice exercised by this animal. Among Crustacea, *Cambarus* is most frequently eaten. Scuds (*Gammarus, Hyallela*) were found in many stomachs. Often only 4 or 5 of these small malacostracans were in an individual, indicating perhaps that the small forms are pursued separately. Aquatic forms dominated among the insects. Burrowing mayfly nymphs, *Hexagenia,* and caddis fly larvae, *Limnophilus,* the latter usually pulled from the cases, as well as burrowing forms of Odonata, large numbers of chironomid larvae, the young of such beetles as *Dytiscus* and *Haliplus,* made up the majority of insects consumed. A few sialids and tipulid larvae, with an occasional *Belostoma,* were eaten. Fish are eaten avidly. *Necturus* has a great fondness for sculpins. Dr. William Senning has told the writer of finding mudpuppies gorged with these fish. The salamander will resort to the mouths of small streams emptying into the lake where the sculpins are secured. Small minnows, *Hybopsis* and *Hyborrhynchus,* are occasionally devoured, but they are apparently too speedy for *Necturus* to catch often. An individual taken in swift water of the inlet to Cayuga Lake had eaten a black-nosed dace.

Annelids eaten were principally large earthworms, but smaller aquatic oligochaetes and leeches were found in many stomachs. Snails, *Limnaea* and *Planorbis,* are frequently taken. One individual had overcome a newt, while several had fed upon *Desmognathus,* probably taken when searching for food among the swift waters of incoming streams. Here they likewise encounter *Eurycea b. bislineata,* for two individuals contained this species. Their own cast skins had been eaten by three, while what appears to be eggs of *Necturus* were swallowed by two. A trace of algae and a not inconsiderable quantity of small flat stones were found in several stomachs. It seems unlikely that the stones were taken in accidentally, for some specimens had nothing but these in their stomachs.

2. *Triturus viridescens viridescens* (Rafinesque)

The food and feeding habits of an aquatic vertebrate, such as the newt, change as quickly as a group of organisms reach their peak, pass and are replaced by another set. During April, in temporary pools, newts may be gorged with *Eubranchipus* one week and in the next mosquito larvae may have taken the place of the fairy shrimp. With this in mind, only a few individuals of any species have been taken at one time, and these in as widely scattered places as was possible.

During late March, newts were observed on several occasions feeding on the eggs of *Ambystoma maculatum.* Stomach analysis shows this to be the important food at this season, but *Cyclops, Asellus* and numerous midge larvae were also found. Three weeks later, in mid-April, the fairy shrimp, *Eubranchipus,* took first place while midges, small snails and cast skins of the newts were also eaten avidly. Early in May the small *Diaptomus* and the mosquito larva, *Aedes,* were consumed greedily, together with eggs of *Rana sylvatica,* many cladocerans and daphnids.

In May and early June the newts were observed feeding on leeches, midge larvae, caddis worms and small water beetles. They appeared to disregard entirely the multitudes of small immature *Corixa, Notonecta,* Odo-

nata and hydrachnids that swarmed in the water at this time. Numerous stomach analyses proved this to be correct. Many of the pools under observation dried up during the midsummer, but while some dampness remained in the vegetation on the bottom, the newts were to be found concentrated in large numbers. Examinations of the stomachs of a considerable number at this time found them to be feeding upon thrips, mites, spiders and small beetles as well as an occasional small snail.

In small pools about the lake, newts were observed courting and feeding the second week of October. The food at this time was snails, scuds, *Asellus,* caddis worms and an occasional small minnow. The last newts were secured on November 20. At this time the water was quite cool, but all examined had eaten well. Small snails, water beetle larvae (*Haliplus*) and many scuds were the dominating food items at this period. At this late date the courting act was frequently observed.

3. *Plethodon glutinosus* (Green)

Sixty-four stomachs were studied. Insects constitute 48.8; sowbugs, 16.2; annelids, 11.4; centipedes, 11; spiders, 5.7; slugs, 2.4; snails, 1.6; and extraneous matter, 3 per cent of the food. About half of the food consisted of insects. Ants, beetles (principally weevils, chrysomelids, lampyrids and small staphylinids), jassids, and a few miscellaneous forms make up this class. Centipedes, while forming only a little more than ten per cent of the food in bulk, were found in over half the animals examined. These chilopods, notably the small forms, seem to be a favorite and readily secured item of food for all terrestrial salamanders.

4. *Plethodon cinereus* Green

Two hundred fourteen stomachs examined. Fifty-seven per cent of the food eaten constituted insect remains. About half of these were ants, a third small beetles and the remainder lepidopterous larvae, Diptera and undetermined insects. Spiders and mites make up 17 per cent; sowbugs, 11; extraneous matter, cast skins and small worms form about 12; while a trace of small molluscs, thrips and undetermined matter make up the remainder. A small acarinid spins a silken cocoon on the fallen needles of hemlock. The salamanders must have either a keen sense of sight or smell, for many stomachs contain a single needle, with the attached cocoon and enclosed arthropod, which does not equal a tenth the volume that the leaf occupies.

5. *Gyrinophilus porphyriticus* (Green)

Beetles, 14.2; stoneflies, 13.4; salamanders, 10; cast skins, 9.4; midge larvae, 8; hymenopterous remains, 7.8; centipedes, 6.5; mayfly nymphs, 5.2; caddis fly larvae, 5; snails, 4; annelids, 2; spiders, 1, and extraneous matter, 13.5 per cent. Much of the food taken was secured under water, in swift spring runs. The salamanders eaten were *Desmognathus.* The water in which these purple salamanders were secured is primarily of side hill inception, and springs arising above boggy areas. The water flows over numerous stones and constantly covers them to a depth of one inch or more. Under such stones the salamanders were found. The stomachs of twenty-six were examined.

6. *Desmognathus fuscus fuscus* (Rafinesque)

Forty-three animals were opened. Stonefly nymphs, 21.5; annelids, 15; centipedes, 13.7; lepidopterous remains, 11; beetles, 9.4; cast skins, 8.1; miscellaneous insects, 7.9; ants, 3.5; and foreign matter, 7 per cent. A trace of hemipterous parts, a few mites, spiders, tipulids and snails were present. Several specimens were taken under water. These were feeding largely on aquatic forms.

7. *Eurycea bislineata bislineata* (Green)

Forty-seven examined. Beetles and their larvae, 16.2; spiders, 14; sowbugs, 13.7; mayflies, 10.5; diptera, 10; annelids, 9.8; stonefly nymphs, 5.4; thrips, 5, and undetermined insects, 9 per cent; also a trace of midge larvae, hymenopterous insects and sand. Many of the salamanders were taken from streams, some wholly submerged in fast water. These were feeding upon minute nymphs of stoneflies and mayflies, with an occasional midge larva. Several examined in January had eaten well, in spite of freezing temperatures and much ice in the streams.

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Mating of the Box Turtles[1]

By Alvin R. Cahn and Evert Conder

Inasmuch as the actual mating of turtles is not often witnessed and as there are very few published descriptions of the process, the following brief note pertaining to the box turtle *Terrapene carolina carolina* is offered.

The individuals concerned are a large male and a medium sized female. These turtles, native Illinois specimens, had been kept in a sand-floored box in a warm room over winter. They were active all winter under the warm conditions in which they found themselves, and had fed quite regularly upon apple, potato, banana, lettuce and hamburger. At 7 o'clock on the morning of April 11 they were found in copulation; how long they had been in this condition is not known, but they did not separate until 8:45 A.M. At the time they were discovered, the female was standing quietly in the sand, entirely in repose, with head partially drawn in, and eyes closed. The male, on the other hand, was leaning far backward, poised almost erect on the posterior end of his carapace as shown in the accompanying photograph. The posterior margin of his plastron was in contact with the carapace of the female, both tails being hidden from view from above by this contact. He, too, was almost motionless, the hind limbs still with muscular tension, the anterior limbs partially relaxed, the fore feet dangling limply. His head was out, and as he looked from side to side, or stretched his neck to the utmost to peer down along his plastron at the female literally at his feet, one could easily imagine an

[1] Contribution from the Zoological Laboratory of the University of Illinois, No. 421.

expression on his face depicting a mixture of pride and astonishment at the acrobatic feat he was successfully performing. The turtles were picked up and turned over so as to determine the location of the feet of the male. These were discovered pressed into the inguinal angle of the female, just posterior to the inguinal elements of her shell, almost buried in the soft parts of that region. Thus the legs of the female were outside those of the male. She, in turn, had her legs pressed firmly against the outer surface of those of the male, the inner surface from the heel almost to the knee holding his legs in place as in a vice. So great

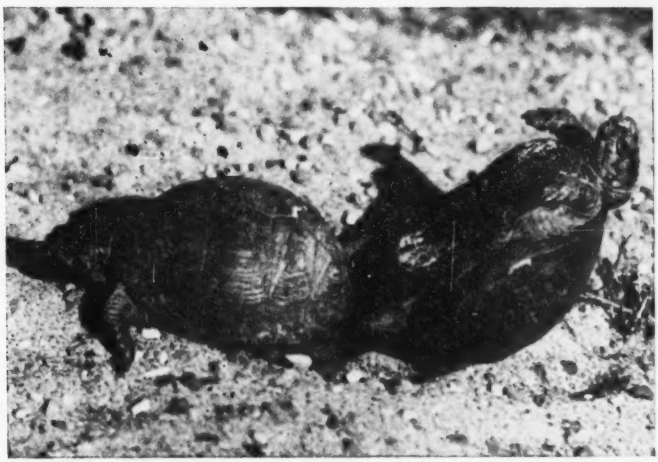

Fig. 1.—Photograph of box turtles in copulation, showing the nearly vertical position of the male.

was the pressure exerted by the turtles jointly that I could get no movement of the leg of the male by any reasonable amount of manipulation on my part. Under the edge of the carapace of the female the tails were in juxtaposition, vent to vent, the tail of the male turned to the left, that of the female to the right. On being replaced in their proper position, the female made a feeble effort to crawl, but due to the fact that only her fore legs were available for that purpose and because she was rather heavily anchored posteriorly, she could not budge. So she gave up the effort, closed her eyes, and remained motionless until separation occurred. In order to separate, the male pushed himself away from the female by straightening his hind legs. This brought him to a more erect position and increased the space between his plastron and the carapace of the female. Then, the hind legs still in place, the extruded penis was withdrawn from the anal opening of the female, after which she promptly released his legs, permitting him to fall over backward, plastron in the air. Following the separation, the penis remained extruded for probably ten seconds; after its retraction the male righted himself, but remained in a sort of dazed condition, motionless, for nearly two

hours. The female, on the other hand, went off about her business with entire unconcern.

As has been said, the initial stages of the copulation were not observed, but it is not difficult to postulate from the facts we know what probably happened. Were the female not willing, copulation could not occur, for she could easily stop the affair by closing her plastron and thereby conceal both her hind legs and her tail. Therefore the female, being

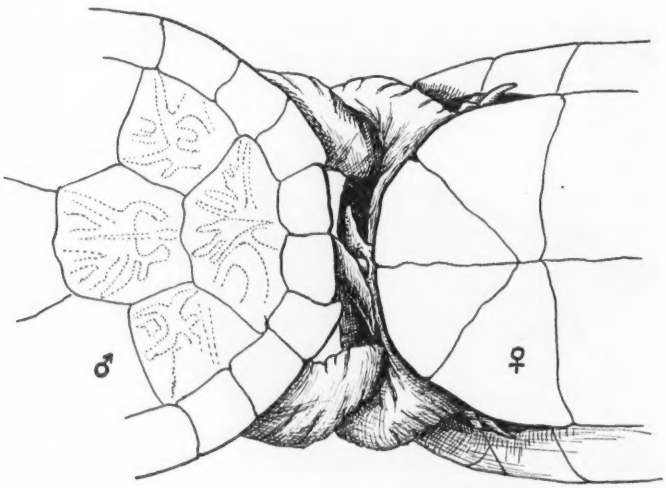

Fig. 2.—Diagrammatic drawing showing the position of the hind legs of the turtles during copulation. Drawing made from below, looking up at the ventral surface of the plastron of the female.

agreeable, probably assists the male somewhat by raising up on her hind legs after he has crawled up on her carapace, his hind legs, however, remaining on the ground. Once in this position, the next step must be for the male to get his hind feet in place, for a vent to vent contact is impossible from his present location. His legs in place, he falls backward, this throwing his long tail, with the anus located beyond the edge of the carapace, under that of the female, bringing vent against vent. Only then is it mechanically possible for the penis to be inserted.

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The Colubrid Snakes of the Greater Antilles

By E. R. Dunn

FOR some years I have considered that a re-examination of the generic characters of the Greater Antillean Colubridae might not only give some new insight into the relationships of these snakes, but also throw some additional light on the relations of the islands themselves to the mainland. I have from time to time made a few notes on specimens in the Museum of Comparative Zoology with this idea in view, and recently examined most of the species in the National Museum. I am duly grateful to the authorities of these institutions.

In the West Indies the genus *Natrix* is known only from Cuba, and there only on the north coast. The species is the Floridian brackish water form *Natrix compressicauda*. It is obviously a chance migrant across the straits.

The genus *Tretanorhinus* is likewise only from Cuba and the Isle of Pines. Amaral considers the Cuban and Central American specimens as conspecific. At any rate they are closely related. They are all aquatic, and the Panamanian form seems more or less addicted to brackish water.

The recent lists of West Indian forms give six more Greater Antillean genera: *Dromicus, Alsophis, Arrhyton, Hypsirhynchus, Uromacer,* and *Ialtris*.

Amaral considers the first two, *Dromicus* and *Alsophis,* as congeneric, calls the lot *Leimadophis,* and includes in this genus many forms from lower Central America, South America and the Galapagos, none further north on the mainland than Costa Rica. Amaral's arrangement is not yet to be accepted unquestionably and I rather think that several natural groups are included in his big genus *Leimadophis,* but we do not need to look outside its limits for the relationships of the West Indian forms. I have satisfied myself that the only superspecific difference between these is the presence of two well developed scale pits in one series of forms (*Alsophis,* which are rather large and uniform in color) and one poorly developed scale pit in another series (*Dromicus,* which are smaller, and usually striped). These two series extend throughout the West Indies, as Barbour has pointed out, usually with a single species of each on every island. The two series have been considered genera by almost all workers on West Indian herpetology, and no serious error will ensue if they are so considered in this paper. They are extremely closely related and it may be years before sufficient examination of mainland material shows whether the division between them took place before or after they reached the islands. I shall here consider (as a conservative position) that the division took place on the mainland.

The normal condition in *Dromicus* and *Alsophis* is a species of each on each island. The usual lists give two species of *Dromicus* (*ater* and *callilaemus*) for Jamaica, and no *Alsophis*. This anomaly can now be eradi-

[1] Contributions from the Department of Biology, Haverford College, No. 11. Paper presented at the Washington meeting of the Society, May 5, 1932.

cated, as *ater* very definitely has two scale pits, is large, uniform in color, and is closely similar to *A. melanichnus* of Hispaniola. *Callilaemus* on the other hand is, as usually considered, a *Dromicus* with one rather indistinct pit.

On Hispaniola two species of *Alsophis* (*anomalus* and *melanichnus*) have been known for some time. This abnormality is not readily explicable but may seem more normal when it is realized that Hispaniola also harbors two quite distinct species of the other series, *Dromicus.*

The snake long known as *Hypsirhynchus ferox* has suffered under an incorrect description of dentition by Günther and Boulenger, who failed to observe the separate pair of long fangs at the hind end of the maxillary, and an incorrect figuring of the hemipenis by Cope, who failed to dissect the organ to its bifurcate end. The dentition and hemipenis are identical with those of both *Dromicus* and *Alsophis.* The snake has a single poorly developed scale pit. It is thus strictly a *Dromicus,* and is, in fact, strikingly similar in general appearance to *D. callilaemus* of Jamaica.

With *Hypsirhynchus* relegated to the limbo of discarded genera, we may consider the three endemic West Indian genera, *Arrhyton, Uromacer,* and *Ialtris,* which have been thought to be related to various mainland forms, or to be relict genera of isolated position.

The dentition of West Indian species of *Dromicus* and *Alsophis* is practically identical and is: maxillary teeth increasing posteriorly, followed after a gap by two enlarged fangs; mandibulary teeth longest near the anterior end. The only modification necessary to this diagnosis is that I find the mandibular teeth of *D. stahli* subequal.

The hemipenis in all species of *Dromicus* and *Alsophis* examined has the sulcus forked close to the base, the organ distinctly bifurcated, and the basal portion beset with hooks which increase in size and diminish in number up to the region of forking, whence they are replaced by calyces. No mainland snake is known to have a similar hemipenis save *D. chamissonis* of the west coast of South America, as figured by Cope. The spines tend to avoid the region of the sulcus and tend to be arranged in longitudinal rows or bands. The calyculate tips have a free proximal edge in *D. stahli* and in *A. angulifer* and are hence "capitate"; there are very few, rather uniform, spines in *A. anomalus,* and the organ is markedly shorter in *D. callilaemus* and in *D. stahli* than in the other species. These variations I regard as merely specific.

What I have to say about conditions in *Arrhyton, Uromacer,* and *Ialtris* may be briefly summarized: the hemipenis of these three genera is practically identical with that of *Dromicus* and of *Alsophis.* The dentition is of the same general character.

Arrhyton has fewer maxillary teeth; 6 plus 2 in *taeniatum,* 10 plus 2 in *vittatum;* the mandibular teeth are subequal. Since *Dromicus ferox* has only 11-12 plus 2 maxillary teeth, and since *Dromicus stahli* has subequal mandibular teeth, the dental differences between *Arrhyton* and *Dromicus* are small. There are no hemipeneial differences. *Dromicus* has one poorly developed scale pit, *Arrhyton* has none. Both groups are usually striped. *Arrhyton taeniatum* lacks a loreal (as does *Alsophis ater*). *Arrhyton vit-*

tatum has this scale. The differences between the two species are at least as great as the generic differences between *Arrhyton* and *Dromicus*. It has been suggested at one time or another that *Arrhyton* was related to *Contia, Leptocalamus* or *Trimetopon,* all three mainland genera (although no *Contia* is known from south of the United States). I can definitely assert that great differences in dentition and hemipenis exist between *Arrhyton* and the three genera mentioned. *Leptocalamus,* which is said to have the same type of dentition by Boulenger, certainly has not. *Arrhyton* has 6-10 maxillary teeth, increasing posteriorly, followed after a gap by two enlarged fangs; *Leptocalamus* has 3 subequal maxillary teeth followed immediately by two enormously enlarged flattened fangs. The hemipenis of the two is totally different. Neither *Trimetopon* nor *Contia* has a gap in the maxillary dentition, neither has markedly enlarged hinder teeth, the hemipenis of the two are not alike and neither of them resemble *Arrhyton* in this respect. The only known genus, then, which is really like *Arrhyton* is *Dromicus,* and I regard *Arrhyton* as a Cuban endemic derived from Cuban *Dromicus.*

With *Uromacer* the story is the same. The genus is confined to Hispaniola and its outlying islands. Both hemipenis and dentition of *U. catesbyi* (the least modified species) are practically indistinguishable from those of *Dromicus parvifrons protenus.* Both have a single, poorly developed scale pit. Both have a dark line through the eye. No known mainland treesnake has the generic characters of *Uromacer.* I therefore regard *Uromacer* as a Hispaniolan endemic derived from Hispaniolan *Dromicus.*

Ialtris has the maxillary dentition of *Dromicus* and *Alsophis* save that the two hind fangs are grooved. It has been shown in many instances that the American back-fanged snakes are not a natural group. *Mimometopon* is but an *Amastridium* with grooves on the hind teeth. *Coniophanes* bears the same relationship to *Liophis,* as does *Leptodeira* to *Hypsiglena* and *Sonora* to *Contia.* In *Ialtris* there is a gap in the mandibular dentition, but apart from the gap the mandibular dentition is that of *Dromicus* and *Alsophis.* The tips of the hemipenis are rather plicate than calyculate, but otherwise the organ agrees quite with that of *Dromicus* and *Alsophis.* There are two scale pits. I therefore regard *Ialtris* as a Hispaniolan endemic derived from Hispaniolan *Alsophis.*

The three endemic Greater Antillean genera are not on the same footing. *Arrhyton* is scarcely different from *Dromicus. Uromacer* differs from *Dromicus* chiefly in color and proportions. *Ialtris* is abundantly distinct from *Alsophis,* and is far and away the most respectable of the three genera.

The picture of the Greater Antilles which these facts give us is obvious. The emigration of Colubrid snakes into the West Indies consisted of four forms at most. These forms were of four genera at most. One entered from Florida, and the other three from Central America . . . . three generic types from Central America out of a colubrid population of at least 60 genera. When one considers that the smaller and more remote Galapagos received one generic type from the mainland, and when

one considers that of the four types in Cuba two are aquatic and brackish water forms, Colubrid snakes show no more reason for a land connection between the Greater Antilles and the mainland than they do for a similar connection between the Galapagos and the mainland. That neither *Natrix* nor *Tretanorhinus* got farther than Cuba, and that *Arrhyton* is restricted to Cuba, and *Uromacer* and *Ialtris* to *Hispaniola,* certainly does not support land connection between the islands themselves.

Thus the Colubrid snakes of the Greater Antilles show the same picture of the origin and history of the fauna that has been previously shown by the hylas, the bufos, the eleutherodactyli, and the species of *Tropidophis,* i.e. by all the herpetological groups that have been carefully examined with proper regard to the amount of insular endemism. In all these groups local endemism has produced a large fauna that has given the impression of numerous migrations from the mainland, and hence of mainland connection. But, in all these groups, when the factor of local endemism has been given its proper weight, the impression arises of relatively few migrations from the mainland (extraordinarily few when one considers the enormous number of Central American genera), and begins to cast considerable doubt on any land connection of the Greater Antilles with the Central American mainland, and the fact that the endemism is of a different character in different islands does not speak very well for the connection between them.

Note: The type of *Dromicus* is *cursor,* and the type of *Alsophis* is *antillensis.* The type of *Leimadophis,* which Amaral uses for the entire group, is *almadensis.* It has a similar dentition, but the hemipenis is quite different, being capped with apical disks. The only mainland form *known* to have dentition and hemipenis both like that of the West Indian forms is *chamissonis,* as figured by Cope. This west coast species is considered by Amaral to be conspecific with the various forms described for the Galapagos, so that we are pretty safe in saying that the closest *known* relatives of the Greater Antillean Colubrids are forms of the west coast and of the Galapagos.

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Egg Laying and Incubation of *Pseudemys floridana*

By C. C. GOFF AND DOROTHY S. GOFF

ON February 8, 1931, at about one o'clock in the afternoon, a *Pseudemys floridana* was found in the process of egg laying. She was about ninety yards from Lake Griffin, Florida, and had chosen an open place among some clumps of grass. She had dug a hole which was about five inches deep and five inches wide. This narrowed down to a couple of inches at the top, thus giving a bottle-necked effect. On each side of the hole, there was a shallow trench in which each foot was fitted.

She was laying eggs when discovered and we were able to approach very close, apparently without disturbing her. As each egg was laid, she would reach down into the hole with first one hind foot, then the other,

possibly moving them into the proper position. Thirteen eggs were deposited while she was under observation, with the following periods, given in seconds, between the laying of each egg: 40, 50, 55, 25, 30, 30, 40, 30, 40, 70, 105 and 35; average, 46 seconds.

As soon as the eggs were laid, she filled the hole and tamped the soil down smoothly over them, until there was almost no evidence that it had been disturbed. This took twenty-nine minutes and as soon as she had finished this she started for the lake.

The eggs were taken up, brought in, and weighed and measured. They were oval in shape, varying only slightly in size, the length being from 36 to 38 mm., and the diameter 25 to 26 mm. The weight varied from 11.5 to 12.5 grams. The total weight of the nineteen eggs was 226 grams. The weight of the turtle after the eggs were laid was 3130 grams.

Fifteen of these eggs were then re-buried in a similar place from which they were taken and at the same depth. About two weeks later one of the eggs was taken up but showed no sign of development.

On March 8, at about the same time of day another *P. floridana* was found laying eggs in the same field but about one hundred and twenty

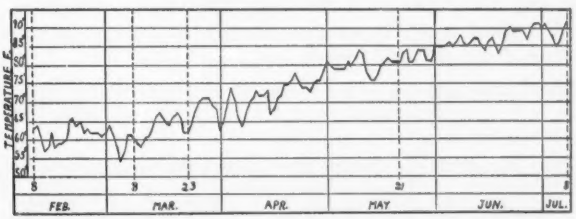

Fig. 1.—Shows average daily temperature from laying of eggs until hatching. Dates mentioned in text indicated by broken lines.

yards from the lake. When approached she became frightened and left the nest. Six eggs had been laid and these were brought in and buried.

At this time an egg of the first set was opened. There was no visible sign of development. The average soil temperature from the time they were buried to this date was 60° F. Two weeks later, on March 23, an egg from each set was opened but still no sign of development was noticeable. The average soil temperature for those two weeks was 63° F. It was not until May 21 that the next eggs were opened. An egg from the first set contained a 15 mm. embryo, and one from the second set had a 10 mm. embryo. The average temperature since March 23 was 74° F., having increased rather gradually from about 65° F. to 80° F.

All others opened were of the first set except one, and this one had died after starting development. In one opened May 31, the embryo was unmistakably a turtle in form, although the head was still large in proportion to the body. The average temperature over this period was 82° F. The last egg was opened on June 30. The yolk sac, now about 12 mm. in diameter, was protruding from the plastron on the ventral median line of the abdominal plate and forepart of the pre-anal plate. A deep groove extended from the median line laterally, dividing the abdominal plates.

The carapace was now 30 mm. long and 26 mm. wide. The average temperature from May 31 until June 30 was 87° F.

On the night of July 8 the remaining eggs of both sets hatched, five of the first set and two of the second set. Since the first set of eggs had been laid a month earlier than the second and they had hatched at the same time, it would seem that the temperatures had been too low during that first month for any development. However, on May 21, the embryo of the egg from the first set was considerably larger than that of the second. The average temperature from June 30 was 88° F.; the day of hatching was the hottest day since the eggs were laid, the average temperature for the day being 92° F.

These young turtles on hatching were very little different from the one taken from the egg on June 30, except that the yolk sac had disappeared. The scar, however, was plainly visible. The grooves in the abdominal plates were now very shallow. In comparison with the adult, these young turtles had some striking differences. The edges of the carapace were more flaring and it was prominently keeled. The width was much greater in proportion to the length and the plates were not so notched, irregular, and out of line as in the adult. The average weight of the turtles, when hatched, was 9.1 grams. After the first few days these turtles fed on algae, duckweed, and bread.

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New Locality Records for Two Salamanders and a Snake in Cattaraugus County, New York

By WILLIAM G. HASSLER

DURING 1931 the Cattaraugus County Department of Health made special studies[1] for the purpose of determining the possible relation of salamanders to water supply pollution. From February 1 to 21, and again from May 8 to July 1 of that year, intensive field work was carried on, of which the author had the good fortune to be in charge. During the course of these investigations a number of interesting observations were made on the distribution and habits of certain local amphibians and reptiles. While a detailed report of these herpetological findings is being prepared, it seems advisable to publish several new locality records at this time.

1. *Eurycea longicauda* (Green)

Seven adult salamanders, typical of this species, were caught during the investigations, all within a few miles of Portville, New York. Three of these, numbers A38055, A38056 and A38057 are preserved in the American Museum of Natural History.

On February 3, three were found in the Catch Basin of the Portville water supply system. This Catch Basin is a covered concrete box about

[1] These investigations were made possible through special grants from the Milbank Memorial Fund. The public health aspects of the problem are being studied by Dr. Edmund K. Kline, Director of the Cattaraugus County Laboratory, under whose direct supervision the work was conducted, and it is expected that a report of this phase of the subject will soon be published.

five feet square, through which all the village water passes just before entering the reservoir. Its purpose is to catch dirt and other foreign objects. This water comes from a series of about eight springs, located along the side of the ridge just east of Lillibridge Creek, between 2 and 3 miles north of Portville. It would be impossible to tell from which specific spring or springs the specimens came. When found they were clinging to the cement wall inside the Catch Basin, several inches above the water level. The air temperature outside the structure was well below freezing, but inside it was about +6° C. The water temperature inside was in the neighborhood of +7°C. One of these three, A. M. N. H. No. A38055, has a total length of 93 mm., and from snout to vent is 39 mm.

The fourth specimen, A. M. N. H. No. A38056, was taken on February 18. It was found while searching among the stones and rubble at the base of a large spring-house on the Lowe Farm at Portville. Here several streams of water seep through a stone wall, and it was in this seepage that the specimen was taken. *Desmognathus* and *Gyrinophilus* were also living there. The spring is approximately on latitude 42° 2′, longitude 78° 20′, at about 1500 feet altitude. The total length of this specimen is 58 mm., and from snout to vent is 29 mm.

The fifth and sixth individuals, both good sized specimens, were found on May 14 in the Lillibridge Creek valley. One was under a stone at the edge of a pile of loose rock on a slight knoll in a pasture, about thirty feet from the creek. According to the topographical map of that section, this point would be where the creek reaches an altitude of about 1860 feet. The other specimen was under a damp board lying in grass, very near the upper end of Lillibridge Creek. The board was about forty feet from the stream. One of these specimens was sent to Dr. Sherman C. Bishop.

The seventh specimen, A. M. N. H. No. A38057, was found a little after midnight, during a heavy rainstorm on June 14. Mr. Clayton H. Sutton, who assisted in the field work during the investigations, caught it as it was walking down through the wet grass on a fairly steep hillside, about fifteen feet from the source of a large spring, and about an equal distance below dense woods. This spring is one of the feeders of a brook that flows south into Dodge Creek near Bedford Corners. This location is about 2 miles north of Bedford Corners, on the Cattaraugus and Allegany county boundary line at latitude 42° 5′. The total length of this specimen is 143 mm., and from snout to vent is 56 mm.

These are the first records of this species occurring in the western part of New York state. The localities are all on tributaries of the Allegheny River which is part of the Ohio drainage system.

2. *Plethodon wehrlei* (Fowler and Dunn)

Three specimens of this species were taken on May 13, several miles northeast of Olean, at latitude 42°6′, longitude 78°22′. They were found under stones at the edge of some woods, on a damp hillside on a ridge that lies west of Haskell Creek, opposite the point where Wolf Run joins the larger stream. The specimens were taken on the west side of this ridge at about 1700 feet altitude. Two of them, A. M. N. H. No. A38058 and A38059, are preserved in the American Museum. The first has a total

length of 103 mm.; and from snout to vent is 57 mm. The second, a total length of 135 mm.; snout to vent 67 mm.

This is the second published locality record for the species within New York state. Bishop (1927) in making known the first, states that a number of specimens were found, "on the hillside opposite the Allegany School of Natural History," in the Allegany State Park. This is about twenty-five miles southwest of the present locality.

3. *Thamnophis radix butleri* (Cope)

Two female specimens, A. M. N. H. No. 46079 and 46080, were taken on May 8, together with a number of *Thamnophis s. sirtalis.* All of these were found under stones on a pasture hillside bordering Lillibridge Creek, where it reaches an altitude of about 1900 feet. At this point a number of small streams flow down the hill from springs higher up. The snakes were near water but not in actually wet places.

In both specimens the preoculars are 1-1; the postoculars 3-3; anterior temporals 1-1; posteriors 1-1. The upper labials are 6-6, and the lower labials are 8-8. The scale formula in No. 46079 is 18 (abnormal)-19-17-15. There are 140 ventrals, and 60 caudals. The anal plate is entire. The total length is 348 mm.; tail 80 mm. In No. 46080 the scale formula is 19-17-15; ventrals 138; caudals 59; anal entire. The total length is 318 mm.; tail 73 mm.

In alcohol the ground color of both is uniform brown. In the smaller specimen the dorsal stripe is very pronounced, with strong dark borders for the entire length of the body. In the larger snake this marking is indistinct except just back of the head. The lateral stripes in both specimens cover half of the second, all of the third and the merest fraction of the fourth row anteriorly; and part of the second and all of the third posteriorly. However, these lateral stripes have darker and more pronounced borders in the larger specimen. The heads of both are typically narrow.

The locality where these were taken is about twenty miles north and slightly west of Port Allegany, the most eastern record for Pennsylvania; and about fifteen miles east and north of Limestone which is the only other locality previously reported for New York state. Like these other two records it is on a tributary of the Allegheny River.

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AMERICAN MUSEUM NATURAL HISTORY, NEW YORK.

Herpetological Notes

ABOUT IGUANAS.—One of the most interesting plants but recently introduced into Central America is the quick growing but short lived papilionaceous tree *Sesbania grandiflora* Poir. The succulent flowers are excellent in a salad and in Ceylon are also a common ingredient in curry.

One of these trees about 30 feet high stands next the quarters of Mr. James Zetek, the resident Custodian of the Barro Colorado Island Laboratory. While enjoying the hospitality of his upper porch I could look right into the pretty tree with its large ivory white flowers. It fairly swarmed with young and adolescent iguanas. Its branches were too slender to support big ones, but the youngsters came from far and wide to eat the flowers which they could have known nothing about until a few years ago. Several times, and this really was a great surprise, I saw good sized rock iguanas (*Ctenosaura*) climbing clumsily but boldly to the tips of the branches and devouring the flowers with extraordinary relish. These lizards so far as I have observed never climb. To be sure in Mexico one often sees them on cacti or sunning on recumbent tree trunks but in general they are creatures of the stone walls, old ruins, rocky ravines and the semiarid or desert beaches along the dry side of Central America. Not that they mind rain, for they swarm about Tela in Honduras and on the Bay Islands, but not in the rain forest nor climbing trees. I suspect that they tasted fallen flowers torn loose and partly eaten by the tree iguanas, who are constantly letting bits fall as they feast. Presumably when the rock iguanas found how excellent the flowers were they forthwith climbed for more. Moreover, it was most amusing to see their mastery of the situation when they did so and the wide berth given them by the other iguanas. For these really hurried to get far away.

I suppose I should try to find some moral to adorn my simple tale, something about habit-forming flowers perhaps. I cannot seem to think of anything except that lizards like folks may be fussy feeders.—T. Barbour. *Museum of Comparative Zoology, Cambridge, Massachusetts.*

ON *PHYLLODACTYLUS UNCTUS* COPE.—This gecko so characteristic of the Cape region of Lower California has not been found widely distributed. Years ago W. W. Brown took it at Rosario (M. C. Z. 14306) and Van Denburgh recorded it from several localities in the Lower Cape region (Rept. Western N. Amer., 1, 1922: 57). It has not often been found upon the coastal islands. Van Denburgh knew of it only from Ballena Island and from Isla Partida, a detached portion of Espiritu Santo Island. In the spring of 1931, while I was a guest on Mr. Allison V. Armour's exploring yacht Utowana, I had an opportunity to visit Gallina Island, west of Espiritu Santo Island, and under the many flat stones on the grassy summit of this bare islet *Phyllodactylus unctus* was found to be abundant. A dozen or more specimens were secured in a short time. A few days later a single specimen was taken under a stone on the rocky hillside of San Francisco Island.—T. Barbour, *Museum of Comparative Zoology, Cambridge, Massachusetts.*

A PREOCCUPIED NAME IN *ELEUTHERODACTYLUS*.—The recently described *Eleutherodactylus ranoides nubicola* Dunn and Emlen (Proc. Acad. Nat. Sci. Phila., 84, 1932: 23,—from San Juancito, Honduras) is preoccupied by *Eleutherodactylus nubicola* Dunn (Proc. Bost. Soc. Nat. Hist., 38, 1926: 116,—from Cinchona Plantation, Jamaica).

This extraordinary piece of stupidity on the part of the senior author of the later paper should not be visited on the junior author, who collected the new form. Since a change of name is necessary, the designation of *Eleutherodactylus ranoides* **emleni** Dunn is appropriate.—E. R. Dunn, *Haverford College, Haverford, Pennsylvania.*

A CLUTCH OF EGGS OF THE SPECKLED KING SNAKE, *LAMPROPELTIS GETULUS HOLBROOKI* (STEJNEGER).—The eggs of the speckled king snake, *Lampropeltis getulus holbrooki,* and the manner of their laying have recently been described by Edith R. Force.[1] But details connected with the hatching of the eggs of this species have apparently not been recorded. Some of these points brought out during observations on one clutch of eggs may best be set down now, as it may be some time before further data come to hand.

A speckled king snake of moderate size sent to the writer from Tulsa, Oklahoma, about June 1, 1931, by Edith R. Force, deposited six eggs on July 17. One egg that was decidedly longer than the others soon spoiled. The remaining eggs varied in length from 42.1 to 44.8 millimeters and in width from 17.8 to 19.9 millimeters. These measurements lie practically within the limits recorded by Miss Force, although most of her eggs were shorter.

The five good eggs hatched on October 3 and 4. The interval of 77 to 78 days, about two and a half months, from laying to hatching is to be contrasted with the statement of Ditmars[2] that the king snake *Lampropeltis getulus getulus* requires for its eggs "from five to six weeks to complete the incubation." Information of this sort is sadly lacking in the group of king snakes. I can add that a single egg from a set laid by *Lampropeltis getulus boylii* on June 24, 1924, hatched 118 days, nearly four months, later (October 20), and that a set of eggs of the milk snake *L. triangulum triangulum* hatched in a little more than two months after being laid.

The five eggs of the speckled king snake contained two females and three males that measured at birth 267, 270 and 260, 265 and 272 millimeters in length.

The coloration of the little snakes was like the adults except for being duller and paler. They could be described as dull-shiny, blackish slate with the yellow spots dull and pale. The snakes shed their skins in 8 to 10 days, being kept meanwhile in slightly moist, closed containers. The colors were changed after shedding only to the extent of becoming brighter and more glossy.

The egg teeth were shed in 3 to 4 days after hatching.

When the little snakes were 11 to 12 days old they were measured again and, although they had not eaten, all showed an increase in length ranging from 4 to 14 millimeters. This is too much to be ascribed entirely to the obvious errors incident to measuring a live snake.

These brief notes should serve to emphasize our lack of definite information concerning the reproductive habits of these, and other, snakes.

Most of the details mentioned above are summarized in the accompanying table.

SUMMARY OF DATA RELATIVE TO HATCHING OF EGGS OF SPECKLED KING SNAKE

Egg No.	Measurements in millimeters Length	Width	Hatching Dates	Length at hatching (mm.)	Sex	No. days egg tooth retained	No. days to first shedding of skin	Increase in length Oct. 15 (mm.)
1	44.8	19.9	Oct. 4	265	M	3	10	11
2	51.2	17.8						
3	44.0	18.2	Oct. 3	270	F	3	9	14
4	42.1	19.8	Oct. 4	260	M	4	8	12
5	42.2	19.0	Oct. 3	267	F	4	9	12
6	42.9	19.5	Oct. 3	272	M	4	10	4

FRANK N. BLANCHARD, *Department of Zoology, University of Michigan, Ann Arbor, Michigan.*

LENGTH OF LIFE IN THE TIGER SALAMANDER, *AMBYSTOMA TIGRINUM* (GREEN).—As definite authentic records of length of life in amphibians are few, it is thought worth while to note the instances of two individuals of *Ambystoma tigrinum,* the tiger salamander, which have been kept by the writer as office pets.

A cluster of eggs of this species was allowed to hatch in the laboratory in the spring of 1920. The larvae were fed by bringing fresh pond water to them frequently. But the food supply was probably insufficient for, as usual, they soon began to prey upon each other. As they grew larger they were fed earthworms. Still their numbers rapidly decreased, until in June only a single one, the largest, remained.

[1] Copeia, 1930, (2): 32-33.
[2] The Reptile Book, Doubleday Page and Co., New York, 1907: 363.

In July this larva began to show signs of transforming. Early in August his gills had disappeared and he took to land. From then on, for eleven years, he lived in an aquarium of about three square feet, half filled with earth, with a glass pool sunk into it.

The food given this salamander was entirely earthworms when these could be found out of doors, and raw beef at other times, with occasional variation to fish. He always ate greedily, often walking about the cage with three or four earthworms dangling from his mouth. He learned to come and snap for food when the top of the cage was lifted; and if, instead of food, the end of a finger was offered him he would snap onto it and allow himself to be lifted clear of the ground, shaking himself about actively in his efforts to wrench the finger free.

At three years of age this animal was over ten inches long. In November, 1923, he was 10¼ inches. In October, 1924, he was 10½.

Apparently this salamander was not affected by changes of season. The room in which he lived was warmed in winter, so that the temperature was fairly uniform the year around. No record of his activity was kept, but it is remembered that in the early years of his life (while the soil in his cage was still soft and loose) he had a tendency to disappear and remain hidden for weeks at a time. Again, for months at a time he stayed in the water. In fact, the larger part of his life was spent in the pool.

In 1924 an adult female of the same species was put into the cage, and has lived there ever since. This female was brought into the laboratory in March, 1924, and laid eggs a few days later. Though the two remained together thereafter, there was no evidence of breeding and no eggs were laid.

In July, 1931, the male, which had been kept for eleven years, died. He had seemed ill for several months, his body being much bloated while his limbs and tail became more and more skinny. His length after he died was 9¾ inches.

The female, 9 inches long in October, 1931, is still in good condition, with a record of at least seven years of adult life.

Major S. S. Flower has recently[1] reported that in the London Zoological Garden from 1866 onwards there are many records of axolotls living four, five, and six years but that the only record of one living for over seven years is an individual that lived 9 years, 4 months, and 20 days. He also mentioned a "white axolotl" as having lived twenty-five years in the Covent Garden Market. However, if by the term axolotl the permanent larval phase of this species is meant, these instances can hardly be compared directly with those detailed above.—FRIEDA COBB BLANCHARD, *Department of Botany, University of Michigan, Ann Arbor, Michigan.*

ARIZONA RECORDS FROM THE VICINITY OF MORMON LAKE.—*Hyla eximia* Baird. While at Mormon Lake, Arizona, on August 16 and 17, 1931, an interesting amphibian was found. A heavy rain came in the afternoon of August 16. After dark frogs were heard calling near the lake shore, an interrupted chirp of a series of four to six notes often repeated. The maker of the call was found to be a *Hyla,* dull green above with brown spotting. Two males were collected on the first evening. The next day, while walking along the trail to the fire lookout tower, a female was taken. Another male was found near the top of Mormon Mountain. The species, which proved to be *Hyla eximia,* typically of Mexico, was found only on the ground, usually near the lake. Their occurrence so far from their reputed range seems worthy of note. Dr. Dunn has examined the specimens and confirmed their identification.

Pseudacris triseriata (Wied). Common along the grassy banks of Mormon Lake and in the swampy pool on top of Mormon Mountain. An occasional call was heard.

Sceloporus consobrinus Baird and Girard. Common on surrounding hillside regions.

Eumeces obsoletus (Baird and Girard). One specimen from Mormon Mountain.

Thamnophis ordinoides vagrans (Baird and Girard). A nice specimen of the wandering garter snake was found on Mormon Mountain.—F. WILLIS KING, *Biology Department, Wilmington College, Wilmington, Ohio.*

[1] Proc. Zool. Soc. London, 1925: 284.

THE FLAT-TAILED HORNED TOAD IN LOWER CALIFORNIA.—It is to be expected that all of the Colorado Desert reptile forms will eventually be collected south of the boundary line in northeastern Lower California, but, owing to the lack of highways, the Lower California list is not yet as complete as that from San Diego and Imperial counties in California. Thus both Van Denburgh (Reptiles of Western North America, 1922, 1:428) and Schmidt (Amphibians and Reptiles of Lower California and the Neighboring Islands, 1922: 670) comment on the fact that *Phrynosoma m'callii,* the flat-tailed horned toad, is to be expected on the Mexican side of the boundary. Through the courtesy of Mrs. Dorothy Hughes, who brought me a specimen from a point in the Yuha Basin, near the Petrified Forest, and about three miles south of the line, I am able to state definitely that the species occurs in Lower California.

Phrynosoma m'callii is not so common in any part of the desert as is *P. platyrhinos.* The latter also has a much wider range, for it frequents both rocky and sandy areas, and in some localities (as for instance in the southern foothills of the Funeral Mountains in Inyo County) is extremely plentiful. I am under the impression that *P. m'callii* is largely, if not entirely, restricted to sandy situations.

Van Denburgh lists eight specific localities for *P. m'callii,* to which I am now able to add some thirteen. The range is outlined by the following known locality records:

ARIZONA: YUMA COUNTY, near Yuma.

CALIFORNIA: SAN BERNARDINO COUNTY, Needles; RIVERSIDE COUNTY, Palm Springs, Indian Wells, Mecca; SAN DIEGO COUNTY, Borego Spring, Borego Valley (Hotel), Carrizo Creek near old Stage Station; IMPERIAL COUNTY, Arroyo Grande (at U. S. 99), Kane Spring, Westmoreland, Coyote Mountain, Coyote Well, south end Salton Sea, Plaster City, Seeley, Holtville, Midway Well, Sand Hills (at U. S. 80), Fort Yuma.

MAINLAND MEXICO: Northwestern Sonora.

LOWER CALIFORNIA: Yuha Basin north of Petrified Forest.

The type locality is given as the "Great Desert of the Colorado between Vallicita and Camp Yuma, about 160 miles east of San Diego." Following the known route of the Sitgreaves Expedition eastward 160 miles from San Diego this would place the locality close to the present town of Calexico.—L. M. KLAUBER, *Natural History Museum, San Diego, California.*

ASCAPHUS TRUEI STEJNEGER IN MONTANA.—The known range of *Ascaphus trucі* Stejneger has hitherto been limited to the northwestern mountains of the United States within 175 miles of the coast, and has included three states: Washington, Oregon, and California.

The discovery on August 9, 1931, by L. D. Anderson, of Kansas University, of a larval specimen of *Ascaphus* "in a small, swiftly flowing stream a few miles below and to the east of the divide in St. Regis Pass between the Coeur d'Alene Mountains and the Bitter Root Mountains in Montana near Haugen," extends its range inland about 250 miles, including the state of Montana. Further investigations in Idaho probably will reveal its presence there.

Since transformation normally occurs in late June and early July, it is of interest to note that it may occur so late as the middle of August. The data on the specimen states that it was found adhering in the characteristic manner by its labial disk to a rock in water "nearly ice cold," at an elevation of "about 4,000 to 5,000 feet."

The larval form of *Ascaphus* is quite characteristic; no other North American larva of the Salientia approaches it in general external structure. The labial disk, the most conspicuous feature, is in this specimen 9 mm. in length and 9.2 mm. in breadth; the labial teeth are in 3/9 rows. The head and body measure 20.7 mm., the tail 28.35 mm. Only the posterior limbs are developed, measuring 9.3 mm. in total length.

Thanks are due to Dr. Edward H. Taylor, of Kansas University, for calling my attenton to the specimen.—HOBART M. SMITH, *Department of Zoology, Kansas State College, Manhattan, Kansas.*

DESMOGNATHUS FUSCUS OCHROPHAEUS IN VIRGINIA.—On the afternoon of August 17, 1931, I collected for a few moments at each of three points on a spur of Jack Mountain, about two miles east of Monterey, Highland County, Virginia. The first was an almost-dry stream bed on the west face at an approximate altitude of 3,300 feet. *Desmognathus fuscus fuscus* was the only species encountered in this unfavorable spot. The second station was at the same altitude but on the east face. Here a rivulet with larger rocks supported *Pseudotriton ruber ruber, Desmognathus phoca, D. fuscus fuscus,* and *D. fuscus ochrophaeus.* At the last station, 300 feet lower on the east face, a stream several yards wide issued from a deep ravine. In places the stream was completely buried in about a foot of leaves which sheltered one *Diadophis punctatus edwardsii* and one *Thamnophis sirtalis sirtalis. Desmognathus phoca* and *Pseudotriton ruber ruber* larvae were abundant here, *Gyrinophilus porphyriticus* was obtained, and additional specimens of *D. fuscus fuscus* and *D. fuscus ochrophaeus* were secured.

In all, seven specimens of *ochrophaeus* (Carn. Mus. Nos. 5683 and 5688) were taken. These were examined in life by Dr. E. R. Dunn and he readily concurred with my belief that they were referable to *ochrophaeus* rather than to the subspecies *carolinensis.* This record adds an additional form to the salamandrid fauna of Virginia. —M. GRAHAM NETTING, *Carnegie Museum, Pittsburgh, Pennsylvania.*

THE GREEN SALAMANDER, *ANEIDES AENEUS,* IN NORTHERN WEST VIRGINIA.—In July, 1931, the senior author noticed an unidentified specimen of *Aneides aeneus* (Cope and Packard) in the collection of the West Virginia University Museum. This specimen lacked data, but since ninety per cent of the specimens at Morgantown have come from Monongalia or nearby counties it seemed probable that this specimen had been taken locally.

On April 30, 1932, the junior author visited Cooper Rock, Monongalia Co., West Virginia, in search of a strange salamander which had been reported to him. His time was limited but he succeeded in collecting three specimens of *Aneides aeneus,* two of which are now in the collection of the Carnegie Museum.

On May 18, 1932, both of us visited the locality in the company of four other individuals who devoted most of their time to various types of collecting, but who occasionally assisted us. We were about eight hours, from two to ten P.M., in the vicinity, but much of this time was occupied in reaching Cooper Rock and in photographing. We estimated that the time actually spent in collecting *Aneides* amounted to about four hours for each of the authors, and in this period we secured 39 specimens. This total fails to indicate the extreme abundance of the species for at least as many additional specimens were seen but not captured, and fully 20 of the 39 were taken in less than an hour after dark.

Cooper Rock is situated in eastern Monongalia County, about eight miles east of Morgantown, about one mile west of the Preston County line, and six miles south of the Pennsylvania line. The name seems to be restricted to a large rock which overlooks the Cheat River and which is at an altitude of approximately 2,000 feet. However, the half-mile area which we worked is characterized by similar rocks, huge, roughly cubical blocks of sandstone, of the Pottsville series (probably Homewood sandstone). These rocks are more than twenty feet in height and are split vertically, forming cold, damp crevices or tunnels large enough for a man to enter. The faces exhibit longitudinal or diagonal cracks, frequently less than one-half inch in height, and windblown sculpturing. The fine crevices extend into the blocks for an undetermined distance and are so undulating that a small twig can rarely be inserted more than six inches.

Green salamanders are easily located by flashing a light into crevices on the shady faces of the rocks. The specimens lie with their heads almost even with the edge of the crevice and frequently with ventral and dorsal surrfaces in contact with floor and roof of the crevice. When disturbed by a light they back rapidly into the crack. Thus specimens are easily located but are extracted with difficulty. Along one such crevice about nine feet in length eight were seen but none could be secured. The afternoon of April 30 was dull with intermitttent showers and on this occasion two specimens were found resting out on ledges in the tunnel-like

passages and one was found by prying a rock flake from a horizontal ledge. The afternoon of May 18 was bright, hot and dry, and all specimens were found in crevices, ranging from moist to dry; none were found in the open, in wet situations, or very far back in the vertical passages. Specimens were secured in crevices from three to fifteen feet from the ground and it was our impression that the higher crevices were preferred. When handled, specimens were rathr sluggish and some gave off almost as much slime as *Plethodon glutinosus*. None attempted to bite and none "squeaked." A yearling specimen, when poked with a stick, played "possum" with its tiny legs thrust stiffly upwards and was easily slid out of the crevice on its back. Specimens were seen emerging from crevices about 8:30 P.M. and after that time were increasingly numerous, either clinging to the vertical faces or resting on exposed ledges. Much of our time was spent in stripping the bark from dead standing or fallen timber, in turning over rocks, and in tearing moss from rocks. No specimens of *Aneides* were found in these situations but other salamanders were thus secured. Three stomachs contained, respectively: one carabid beetle of the genus *Platynus*, one elaterid beetle, and one large, black ant. One specimen regurgitated an unidentifiable insect.

This record extends the range of *Aneides aeneus* from Baileysville, West Virginia, to Cooper Rock, a distance of 180 miles northeast. The species will probably be added to the fauna of Pennsylvania in the near future. The habitat described differs greatly from that studied by Pope (Amer. Mus. Novit., (306): 6-10) at Pine Mountain, Kentucky. Further studies will be carried out and a more detailed report published later.—M. GRAHAM NETTING and NEIL RICHMOND, *Carnegie Museum, Pittsburgh, Pennsylvania,* and *Fairmont State Teachers College, Fairmont, West Virginia.*

NOTES ON THE BREEDING HABITS OF THE GREEN SNAKE (*LIOPELTIS VERNALIS*).—The green snake has been rather common in the vicinity of the field station of the Fisheries Research Laboratory of the Department of Biology, University of Toronto, at Frank's Bay, Lake Nipissing, Ontario, during the summers of 1930 and 1931.

On August 1, 1931, Mr. Murray Fallis found seven eggs of this species beneath a half decayed board. The eggs were lying in about one-half inch of sand which covered the bed rock. Embedded in the sand were two rather wet pieces of partly decayed shingles. The embryo from one of the eggs, opened the same day as found, was able to crawl but it died during the night. The remainder of the eggs hatched on August 5.

On August 18, 1931, the senior author discovered two snakes of this species copulating. The male was 43 cm. and the female 36 cm. in length. They were discovered about eleven A.M. quite near an old house which was being used as a laboratory and living quarters. They were about a foot from the ground clinging to raspberry canes and tall grass. They were discovered through the barking of a dog, whose attention had apparently been attracted by their movements. When found, their vents were in contact and the male appeared to be firmly attached to the female. Their bodies, except for their vents, were not in contact, their heads being about a foot apart. This position may not have been the normal one as they had no doubt been disturbed to some extent by the dog. Both authors observed them for a few minutes and then caught both specimens. As soon as we took hold of them they became detached from one another.

A few days later, on August 22, Dr. G. H. W. Lucas and Mr. Fry discovered another copulating pair and on this occasion Mr. Fry was able to observe that the male was quite firmly attached to the female in virtue of barb-like projections on the sides of the hemipenis. The position of this pair was essentially similar to that of the one described above.

Both in 1930 and 1931 it was noticed that green snakes were seen much more frequently in August than earlier in the summer. It is not known whether this has any significance or not but it suggests that at mating time these snakes may move about more commonly in the middle of the day than at other times or may then frequent more open situations or be less timid.—J. R. DYMOND AND F. E. J. FRY, *Department of Biology, University of Toronto, Toronto, Ontario.*

AN EXTENSION OF THE RANGE OF FOUR REPTILES TO INCLUDE COLORADO.—*Thamnophis sauritus proximus* (Say). Fourteen specimens of this garter snake were taken from a small stream which runs through the Singer Boys' Ranch, in Furnace Canyon, Baca County. A number of our two common species, *Thamnophis radix radix* and *T. ordinoides vagrans* were found in or near various streams in Baca County, but Furnace Canyon was the only locality where *T. s. proximus* was taken. Baca County occupies the southeastern corner of Colorado. Ten of the specimens are in the collection of the Colorado Museum of Natural History.

Identification of these snakes was confirmed by Miss Doris Cochran, United States National Museum.

Hypsiglena ochrorhynchus Cope. One specimen of this snake was taken by Mr. Donald Watson, of the National Park service. Mr. Watson found the snake lying dead in the road in Mesa Verde National Park, Montezuma County, and presented it to me.

Dr. Charles E. Burt, of Southwestern College, Winfield, Kansas, confirmed our identification of this specimen.

Holbrookia maculata approximans (Baird). Two specimens were brought to me by Mr. Robert Landberg, of the Mammal Department of this Museum. They were collected in the Southern Ute Indian Reservation in Montezuma County, near the point where Interstate Highway No. 666 crosses the Mancos River. Montezuma County is in the southwestern corner of the state.

Our common spotted lizard, *Holbrookia maculata maculata,* has never been recorded in Colorado west of the Continental Divide, and Dr. A. M. Woodbury, in his recent paper on the reptiles of Utah, lists *H. m. approximans* as the only species of this genus found in Utah. It is probable that all specimens of *Holbrookia* taken west of the Divide in Colorado will prove to be *H. m. approximans.*

The two specimens in our collection were identified by Dr. Burt.

Sceloporus magister Hallowell. A specimen of this large swift was taken by Mr. Landberg in the same locality where the two specimens of *H. m. approximans* were found.

It is probable that Montezuma County will furnish further additions to Colorado's list. Two lizards and one snake new to the state were found last summer and only a very small section of this county has been examined.—LEWIS T. BARRY, *Colorado Museum of Natural History, Denver, Colorado.*

THE STATUS OF *APOSTOLEPIS TENUIS* RUTHVEN.—In the Memorias do Instituto Butantan (4, 1929: 224), Amaral synonymized *Apostolepis tenuis* Ruthven with *A. ambinigra* (Peters). The Museum of Zoology has two specimens of *A. ambinigra* as well as the type of *A. tenuis* in its collections. Comparisons with the type descriptions of both forms and with the two specimens of *A. ambinigra,* as well as the re-examination of the type of *A. tenuis,* show further differences than those set forth by Ruthven in his description of *tenuis* (Occ. Pap. Mus. Zool., Univ. Mich., 188, 1927: 1-2).

The most striking features of *A. tenuis* are the color, the elongate form, the slight girth, and the proportionately small head. A comparison of the measurements of our three specimens follows:

	Number	Total length	Tail length	Head width
A tenuis	64436	308 mm.	36 mm.	3.5 mm.
A. ambinigra	67962	338 "	25 "	4.7 "
	67963	341 "	31 "	4.8 "

Thus, although our longest *ambinigra* is but 33 mm. longer than *tenuis,* the head is 1.3 mm. wider, a striking difference in snakes of this size. Also the girth of the body is proportionately greater in *ambinigra,* and the tail is proportionately longer in *tenuis.* The detailed differences are well set forth in the type descriptions.

As Ruthven suggested in his description, *tenuis* recalls *dorbignyi* and is probably quite closely related to it. But to regard *tenuis* as a synonym of *ambinigra* seems so contrary to the facts of morphology and morphometry, that I propose that the name

tenuis be reinstated until more definite evidence that it is a synonym is forthcoming.—NORMAN HARTWEG, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

AN EXTENSION OF THE RANGE OF *HYLA REGILLA* (BAIRD AND GIRARD) INTO ARIZONA.—On July 12, 1930, I collected a number of specimens of *Hyla regilla* (Baird and Girard) eight miles north west of Flagstaff at Fort Valley, Coconino County, Arizona. They were found breeding, at the same time as *Pseudacris triseriata* (Wied), in the shallow ponds in the meadows at the foot of the San Francisco Mountains. Numerous individuals were heard singing in the higher wooded areas, as they came down to the water to breed. This species has been recorded from the west coast from British Columbia south to Cape San Lucas and east to Idaho and Utah. This record extends the range from Utah, Nevada and California into Arizona south of the Colorado River. *Hyla regilla* has never been reported from this area although one might well expect that the species would range down to the southern border of the Plateau region in northern Arizona. Specimens collected are in the Stanford University Natural History Museum, Catalogue No. 2084.—KENNETH L. HOBBS, *Stanford University, Stanford, California.*

FURTHER COMMENT ON THE ACTIVITY OF THE SPADE-FOOT TOAD.—Having read Dr. Stone's interesting note (COPEIA, 1932 (1) : 35) concerning the terrestrial activity of *Scaphiopus holbrookii* and also that on *Scaphiopus hammondii* by Dr. Kellogg, I call to mind certain observations of my own that may be sufficient to warrant their appearance in print.

While encamped in the bottom lands of the Tchoutacabouffa River about three miles north of Biloxi, Mississippi, during the latter half of the month of March and the first part of April, 1932, I noticed that every night the spade-foots came forth, the temperature permitting. I had previously associated the perceptibility of *Scaphiopus* with the fall of rain and have seen it so stated by several authors. It was remarked that all specimens seen or taken did not exceed the length of 25 or 30 mm., excepting one, a full grown individual, observed on a night attended by a light precipitation. At this time the immature specimens were noticed to be more abundant. They were always found hopping about among the leaves and seemed much disturbed at the approach of a light but none attempted escape by characteristic burrowing, this being accomplished instead by a rapid succession of hops.

Bordering the river to a depth of one hundred to two hundred yards is a belt of thick "jungle," formed by magnolia, oak, cypress and other trees and bushes and touching on its outward edge the extensive upland pine woods. In this river belt the spade-foots were numerous, their abundancy decreasing the farther from its margin one proceeded.

The appearance of the species in numbers is undoubtedly coincident with rain, as past experience shows, but this is more applicable to the adult animal, as observers seem as one on the point of capturing the young in greater numbers on dry nights.—MORROW J. ALLEN, *Biloxi, Mississippi.*

ELIMINATION OF *EUMECES FASCIATUS* FROM THE COLORADO FAUNAL LIST.—In response to a recent request, Professor W. L. Burnett of the Colorado State Agricultural College has kindly loaned me one of the specimens upon which he based his report of *Eumeces fasciatus* from 14 miles north of Fort Collins, Colorado (COPEIA, 1932, (1) : 37), after an identification made by Professor J. E. Guthrie of Iowa State College. Examination of the specimen concerned shows it to be a typical example of *E. multivirgatus,* which is a common species in parts of western Nebraska and in eastern Colorado. At least eight narrow dark bands and nine light lines of varying prominence are discernible on the back of this "many-striped" specimen, which has a more slender body and somewhat weaker legs than *fasciatus.* —CHARLES E. BURT, *Southwestern College, Winfield, Kansas.*

Ichthyological Notes

A PECULIAR SNAKE-EEL FROM THE GULF OF MEXICO.—*Crotalopsis punctifer* Kaup (Abhandl. Naturwiss. Ver. Hamburg, Abth. 2, 4, 1859: 13, pl. 1, fig. 3) has been placed by Jordan and Davis, followed by Jordan and Evermann (Bull. U. S. Nat. Mus., 47: 387), in the synonymy of *Mystriophis intertinctus* (Richardson). After an examination of the specimens in the National Museum and comparison of the original descriptions of *Crotalopsis* and *Mystriophis* we entertain some doubt as to the validity of referring *Crotalopsis punctifer* to the synonymy of *Mystriophis intertinctus* and our opinion in this is supported to a certain extent by a specimen taken November 17, 1931, twelve miles off Horn Island, Mississippi, in 60 to 75 feet of water and now deposited in the collections of the U. S. Bureau of Fisheries. Mr. Isaac Ginsburg, in a letter concerning the specimen, calls attention to its agreement in all essential details with Kaup's description and figure.

Believing the specimen to be of considerable interest and even though, as stated by Mr. Ginsburg, it certainly seems to have been described, we nevertheless deem it advisable to publish the following description under the name of

Crotalopsis punctifer Kaup

Description.—Head somewhat compressed. Mouth large; jaws narrow, tapering. Body subcylindrical. Head nearly 5 in body. Snout short, 6 in head. Eyes small, more or less superior, 3.25 in snout. Gill openings subinferior; isthmus 2/3 gill opening. Anterior nostril opening in a short tube halfway between eye and end of snout. Tail slightly longer than head and body. Dorsal fin inserted well behind tip of pectoral. Anal and pectoral fins well developed. Latter 2.8 in head.

Teeth pointed, unequal; two large canines on head of vomer, the posterior one depressible; 4 smaller canines at anterior end of lower jaw; other outer teeth of lower jaw pointed and smaller; no marked canines in upper jaw, outer teeth all rather elongate and pointed and little smaller than lower four canines; teeth on shaft of vomer small and biserial; teeth of upper and lower jaws biserial; inner row small, subequal, those of upper jaw inclining inward.

Head slate color. Body lighter, tinged with brownish particularly along the dorsal fin. Dorsal and lateral surfaces with numerous small, blackish spots that have a scarcely visible tendency to arrangement in indefinite vertical bars. Ventral surface lighter and unspotted. Anal fin margined with black. Distal half of pectoral fin black.

Measurements.—Total length 1,237 mm., tail 640 mm., body 495 mm., head 102 mm., girth 182 mm. Weight, 5 pounds, 8½ ounces.—STEWART SPRINGER AND MORROW J. ALLEN, *Caribbean Biological Laboratories, Inc., Biloxi, Mississippi.*

NUMBER OF ANAL SPINES IN YOUNG OF THE SCIAENID FISH *GENYONEMUS LINEATUS*.—In COPEIA, No. 101, December 20, 1921 (p. 86), I reported that "A young specimen of the common Californian sciaenoid, *Genyonemus lineatus* Ayres, 34 mm. long to caudal, found dead on the beach at Montecito, on the mainland shore of the Santa Barbara Channel, on July 12, 1916, has three unquestionable anal spines." Since then I have examined scores of the young of this species, collected by the staff of the California State Fisheries Laboratory, and have failed to find any with more than two anal spines. Now, through the courtesy of the Field Museum, I have before me the specimen reported on in 1921, and find that I mistook a pointed splinter of tissue for a weak third spine. The observation quoted was therefore an inexcusable error, which I wish to correct.—CARL L. HUBBS, *University of Michigan, Ann Arbor, Michigan.*

THE CALIFORNIAN SPECIES OF THE FISH GENUS *ARGENTINA*.—Gilbert in 1890 (Proc. U. S. Nat. Mus., 13: 56) described as new a species of *Argentina*, the first to be made known for the North Pacific. This species, *A. sialis*, was based on a single small specimen from the Gulf of California. This one example re-

mained the only one known, until 1920, when Higgins (Calif. Fish and Game, 6 (2): 87) reported others from off Huntington Beach, California, where they had been dredged on December 9 and 10, 1919, at a depth of 45 fathoms. On receiving some of these specimens at a recent date, I found that they differed in many details from the type description, and therefore doubted Higgin's identification. On studying the type in the National Museum, however, I learned that it was rather inaccurately described, and that it does in fact agree well with Higgin's specimens. The data follow:

	Type specimen		
	Original Description	New examination	California specimens
Dorsal rays (principal)	11	10	10 (rarely 11)
Anal rays (principal)	12	11?	10 or 11
Scales	40 or 45	48	48
Gill-rakers below angle	25	18	18
Premaxillary teeth	Absent	Not found	Very weak
Depth of body	5.5	6.7	6.5 to 7.0
Eye	3.5	4.25	4.0 to 4.2
Origin of D. to base of C. exceeds origin of D. to tip of snout by	Diam. of pupil	Half eye	Diam. of eye or nearly so
Part of D. above pelvic insertion	Behind middle	Slightly behind middle	Middle
Pelvic inserted midway between base of C. and	Front of orbit	End of 2nd 3rd of snout	Middle part of snout
Pelvic extending toward anal	A little more than half way	Less than half way (but broken)	Less than half way
Peritoneum	Black	Densely punctulate	Punctulate

CARL L. HUBBS, *University of Michigan, Ann Arbor, Michigan.*

AN ADDITION TO THE FISH FAUNA OF THE UNITED STATES.—A new addition to the fish fauna of the United States was made on March 31, 1931, when the writer collected a specimen of *Hemianthias peruanus* Steindachner in the markets at Redondo Beach, California. This species had been recorded once before off the coast of Lower California, at Albatross station 3017. Otherwise it has been recorded from Chile and Peru.

The individual in question had been freshly caught within a short distance of Redondo Beach. Its striking color was rose red with the following yellow marks: a streak starting at the edge of the preorbital on a level with lower border of eye, then disappearing to reappear on posterior, lower border of eye, and thence continuing for a short distance toward upper end of preopercular edge. Many yellow specks on opercle. Many yellow spots on sides below lateral line. Yellow on membranes of spinous dorsal, and on tips of soft dorsal rays. Much yellow on distal half of caudal, and a few spots of yellow-green on basal half of caudal. Anal with some yellow on tips of rays. Ventral fins with a few yellow spots toward base and some on the tips of the rays. Rest of fins are red. Peritoneum white. Buccal and gill cavities white.

The fins of this fish were not as filamentous as described by Boulenger or by Jordan and Evermann. Body length, 255 mm. Oblique rows or scales, 74. Pores of lateral line, 65. Gill-rakers on lower arm of anterior arch, 25. Third dorsal spine, 1.75 in head. Third ventral ray, 1.5 in head. The specimen is now in the collection of Stanford University, Cat. No. 24812.—JOSEPH H. WALES, *Stanford University, California.*

REVIEWS AND COMMENTS

BETTER TROUT STREAMS. THEIR MAINTENANCE WITH SPECIAL REFERENCE TO TROUT HABITS AND FOOD SUPPLY. By Edward R. Hewitt. Charles Scribner's Sons, New York and London, 1931, 140 pp. $3.00.—This little volume is an important contribution to that branch of economic ichthyology which is concerned with sport fisheries. One must agree with the author when he states..."comparatively little work has been expended on the...effect of stream conditions on fish life." This book, dealing as it does with the methods of studying and improving trout streams, helps to fill a wide gap in American fishery literature.

In ten brief chapters, Mr. Hewitt has given a surprising amount of information about trout, their stream environment, and methods of improving conditions for fish production. Anyone interested in trout streams will find his book very stimulating, because of the author's clearly defined statements of what is needed in maintaining a supply of trout adequate to present-day demands.

A statement of what production can be expected of a stream is given and methods of increasing trout production up to this limit by improvement of environmental conditions are outlined.—JOHN R. GREELEY, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

A PRELIMINARY REVISION OF THE GENERA OF THE GOBIOID FISHES WITH UNITED VENTRAL FINS. By Frederik Petrus Koumans. Drukkerij "Imperator" N. V.—Lisse. Doctorate Dissertation. [1931]: 174 pp.—A bold task was essayed for his doctorate work by the young Dutch ichthyologist Koumans, who has succeeded the late Dr. Canna M. L. Popta as curator of fishes in the Leiden Museum. But the task was well done and ichthyologists over the world are presented with a vitally needed contribution. So speciose is the group, and so extensive and complicated and notoriously difficult has been its generic classification, that any general comparison of the genera had become almost impossible until this work appeared. This revision is especially opportune, as it follows and coordinates recent extensive generic separations by de Buen and Iljin in Europe, Herre in the Philippines, Smith in Siam, Whitley in Australia, and by others. Inasmuch as many genera could be known to the author only through descriptions, or through a few old museum specimens, he naturally could not apply through the group the characters of the head sense organs which are regarded by modern European writers as of high value in the classification of the gobies.

Never before has the classification of the gobies been brought into as satisfactory a state as at present, though no one will look on Kouman's monograph as more than a tool leading toward a better arrangement. Ichthyologists everywhere may well hope that the author will be bold enough to tackle the genera of gobies with separate ventral fins (the Eleotridae), and eventually to bring together a revision of the species as well as the genera of gobies.—CARL L. HUBBS, *University of Michigan, Ann Arbor, Michigan.*

MEXICAN TAILLESS AMPHIBIANS IN THE UNITED STATES NATIONAL MUSEUM. By Remington Kellogg. Bull. U. S. Nat. Mus., 160, 1932: IV+244 pp., 24 figs., 1 pl.—The long awaited paper on the frogs of Mexico has appeared recently, and amply fulfills expectations. Especially interesting is the historical account of the source of the National Museum Mexican collections. Detailed descriptions of the species are included in the keys. Under the separate species headings the description is amplified when necessary, and there is a discussion of the synonymized forms. While there are no startling changes in classification, the herpetologist will take pleasure in noting that the synonymy of *Rana pipiens* includes many of the species that have been doubtfully recognized, and that the ghost of *Rana halecina* is finally laid. The excellent text figures are original. Dr. Kellogg has expended much patient work in its preparation and he is to be congratulated on the completion of a volume which promises to be of the greatest usefulness.—HELEN T. GAIGE, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

EDITORIAL NOTES AND NEWS

Summary of the 1932 Meeting

THE fifteenth annual meeting of the American Society of Ichthyologists and Herpetologists was held at the United States National Museum, Washington, D.C., from May 5 to 7, 1932. All of the sessions were well-attended, as the audiences ranged in number from 30 to more than 50.

The morning session on May 5th was called to order by President E. R. Dunn at 10:00 A. M. The following papers were read and discussed, and one exhibit was presented.

1. The **Eumeces fasciatus** complex—Edward H. Taylor.
2. Notes on **Anolis stejnegeri** Barbour—M. K. Brady.
3. Variation in **Tantilla coronata** Baird and Girard—O. C. Van Hyning (read by Mr. Brady).
4. The colubrid genera of the West Indies—E. R. Dunn (published in this number of COPEIA).
5. **Crotalus oreganus cerberus**, a valid subspecies—Grace Olive Wiley.
6. The function of the facial pit of the pit vipers—G. K. Noble.
7. The status of **Tropidoclonion lineatum**—E. R. Dunn (to be published in COPEIA).
8. Hybridizing diamond-back terrapins—Samuel F. Hildebrand.
9. The incubation period of the turtles of western New York—E. H. Eaton (read by Mr. Odell).

Exhibit of "Nip" and "Tuck" Siamese Twin Snapping Turtles—Grace Olive Wiley.

Business Meeting

AT 3:00 P. M. the President called the annual business meeting to order, with 24 members present. The minutes of the previous meeting and the report of the Secretary were read and approved. In spite of the increase in dues, coming during a period of widespread depression and unfavorable exchange rates, which resulted in the resignation of many foreign members, the Secretary reported the addition of 44 new members and of 3 new subscribers during the year, resulting in a net gain of 12 over last year or a present total of 433 members and subscribers.

The report of the Treasurer, covering the period from July 1, 1931, to May 4, 1932, was read by the Secretary, and was duly approved. Receipts for this period were given as $1,786.76, distributed as follows: funds received from the former Treasurer, $328.20; annual dues, $838.05; subscriptions, $148.10; contributions to the Stejneger Anniversary Number, $164.00; sale of reprints, $167.65, and sale of back numbers, $140.76. Expenditures for the same period were given as $1,360.65, allocated as follows: publication of COPEIA (3 numbers), $1,027.45; printing of reprints, $149.50; photostating exhausted back numbers, $76.20; postage, $39.69; stationery and miscellaneous printing, $55.75; miscellaneous, $12.06. The balance, as of May 4, 1932, was $426.11.

The report of the Editors was given by Dr. Hubbs, and was duly approved. He announced that a new contract had been made with the printer under which COPEIA is to be printed at a charge of $4.25 per page for 700 copies on 50 per cent rag paper.

Dr. Dunn, who represented the Society at the meeting of the Union of American Biological Societies at New Orleans, reported upon the meeting dealing with Biological Abstracts. Following a lengthy discussion the Society passed a motion that the Secretary be instructed to write to the editor of Biological Abstracts requesting that separates of the various sections be issued and be offered for sale at a small annual fee.

Dr. Noble read the revised constitution prepared by Dr. Gregory and himself. In a lengthy discussion the members indicated the desirability of giving the Society a longer opportunity to study it. Dr. Noble moved that the Secretary be empowered to re-draft the suggested constitution to provide for the Western Division and for life membership, and that the Secretary send this revised draft to all members of the Board of Governors for their suggestions and corrections, incorporate these, and then send the final draft to the Governors for their vote on acceptance. This motion was carried.

The Secretary discussed the advisability of incorporating the Society. Dr. Noble moved that the officers be given the authority to carry out the incorporation prior to the next annual meeting.

The President appointed a nominating committee consisting of E. H. Taylor, Wm. M. Mann, and F. N. Blanchard. The need for a new check list was discussed.

The matter of the next annual meeting was considered and the Secretary reported that meetings have been held in 8 cities, as follows: Philadelphia—4, Washington—3, New York—2, Cambridge—2, Brooklyn—1, Chicago—1, Northampton—1, Ann Arbor—1, and in 5 months of the year, as follows: May—5, April—3, October—3, March—2, November—2.

On the evening of May 5th many of our members attended the Annual Dinner of the American Society of Mammalogists. Rapid cartoon sketches from the facile crayon of Mr. Berryman and excellent moving pictures presented by Mr. and Mrs. Martin Johnson contributed to the success of this gathering.

Sessions of May 6 THE morning session of May 6th convened at 10:00. The following papers were read and discussed:

10. The differentiated fish fauna of the upper Kanawha River system—Carl L. Hubbs.
11. On the ecological conditions in an oceanic fresh-water lake, Andros Island, Bahamas—C. M. Breder, Jr.
12. A new blind cavefish from Missouri—Carl L. Hubbs.
13. A preliminary study of population stability and sex ratio of **Lebistes**—C. M. Breder, Jr., and C. W. Coates (to be published in COPEIA).
14. Some recent papers on the herpetology of China—C. H. Pope.
15. The eggs and young of the smooth green snake—Frank N. Blanchard.

Following luncheon the afternoon meeting was called to order at 2:00. The report of the nominating committee was presented during the afternoon, and the newly elected President took the chair toward the end of the program. The following papers were read and discussed:

16. **Pseudacris** in the Allegheny Plateau—Charles F. Walker.
17. Notes on **Pseudacris streckeri** and allied forms—A. H. Wright and A. A. Wright (read by Mr. Netting).
18. The amphibians of West Virginia—M. Graham Netting and A. H. Wright.
19. Recent field work in western New York, with special reference to **Gyrinophilus**—W. G. Hassler.
20. Some strange teleost skulls and their derivation from normal forms—William K. Gregory (published in this number of COPEIA).

New Officers THE report of the nominating committee was accepted, and the following officers were elected for 1932-1933: *Honorary Presidents,* Leonhard Stejneger (Herpetology) and John Treadwell Nichols (Ichthyology); *President,* C. M. Breder, Jr.; *Vice-Presidents,* Sherman C. Bishop, Doris M. Cochran, John R. Greeley; *Secretary,* M. Graham Netting; *Treasurer,* A. W. Henn; *Ichthyological Editor,* Carl L. Hubbs; *Herpetological Editor,* Mrs. Helen T. Gaige.

Annual Dinner THE annual dinner of the Society was held on the roof of one of the wings of the Reptile House of the National Zoological Park. Seventy-four persons were present. Following the dinner a short time was devoted to final business. At an informal meeting, the Governors present instructed the Secretary to request opinions from the various members of the Board as to the time and place of the next annual meeting.

Dr. Carl L. Hubbs, Chairman of the Committee on Resolutions, presented the following to the Society. These were passed unanimously.

Whereas, a large number of ichthyologists and herpetologists of countries using non-Latin alphabets are publishing their papers in the English language,

Therefore be it resolved, that the American ichthyologists and herpetologists, through their Society, desire to thank their fellow scientists of other lands for publishing in English.

Whereas, The American Society of Ichthyologists and Herpetologists has just experienced a very successful and enjoyable meeting, owing largely to the efforts and hospitality of the Local Committee, and the officials of the U. S. National Museum and National Zoological Park,

Therefore be it resolved, that this Society expresses its sincere thanks for these efforts and this hospitality.

The members and their guests were entertained with a reel of movies treating "Unusual Happenings in Reptile Life," made and presented by Grace Olive Wiley. Dr Waldo L. Schmitt presented an unusually fine reel of undersea pictures taken by himself at Tortugas. Following the moving pictures, the gathering adjourned to the corridors of the Reptile House. Dr. Mann kindly arranged to have feeding take place at this time, which added a most interesting feature to the numerous excellent displays.

On Saturday morning the Society gathered with the American Society of Mammologists at the National Zoological Park, and after making a very interesting tour of the Park, the members of both Societies were served with an excellent buffet luncheon in the grounds. The meeting of the Society came to a close following this luncheon.

This report on the Washington meeting was furnished by the Secretary.

Meeting of Western Division

THE fourth annual meeting of the Western Division of the Society was held in Science Hall, Washington State College, Pullman, on June 17, 1932. This was a joint meeting with the Pacific Northwest Bird and Mammal Society. At a short business meeting, the following officers were elected: B. W. Evermann, California Academy of Sciences, President; V. M. Tanner, Brigham Young University, Vice-President, and L. E. Griffin, Reed College, Secretary-Treasurer.

Exhibits of living material were as follows: *Eumeces skiltonianus, Uta s. stansburiana, Sceloporus graciosus gracilis, Chrysemys picta belli, Pituophis catenifer heermanii, Thamnophis ordinoides vagrans, Coluber constrictor mormon, Triturus torosus, Ambystoma macrodactylum, Bufo boreas boreas* and *Scaphiopus hammondii* from the northeastern part of Oregon, all by J. S. Brode, Pendleton, Oregon; *Masticophis taeniatus,* by P. H. Pope, Whitman College; *Scaphiopus hammondii* in burrow from central Oregon, and Oregon rattlesnake by Arthur and Ruth Svihla, Washington State College; *Ascaphus truei, Scaphiopus hammondii* (adult and tadpoles), *Rana pretiosa* (alpine variety from Washington state) and a *Rana* of undetermined species from British Columbia, by J. R. Slater, College of Puget Sound. Museum specimens of amphibians and reptiles of Walla Walla prepared by the paraffine infiltration method of Noble and Jaeckle were exhibited by W. J. Brooking and P. H. Pope, Whitman College. Cleared specimens of *Ascaphus truei* and *Rana pretiosa* were shown by Arthur Svihla.

The following papers were presented:

Observations on the life history of **Ascaphus truei**—P. G. Putnam (read by L. E. Griffin; these observations were published in COPEIA, 1931, No. 3).

Herpetology of Whitman County, Washington—Arthur Svihla (to appear in COPEIA).

Nesting habits of the crested blenny, **Anoplarchus purpurescens**—Leonard P. Schultz and Allen DeLacy (to be published in COPEIA).

Ecology and adaptations of the reptiles of sand deserts—W. Mosauer (slides and motion pictures; published in this number of COPEIA).

The cyprinoid fishes of Lake Lanao, Mindanao, Philippines, and their evolution—Albert W. Herre (from his study of the fishes on the islands north and east of Borneo, the author concluded that seventeen species or subspecies which he has described from Mindanao must have developed from the one species **Barbodes binotatus**; this was pointed out as a fine problem in evolution for some young biologist; the new species from Lake Lanao will be described in the next number of COPEIA).

Feeding habits and moult of **Crotalus confluentus** in captivity—Tracy I. Storer and Beryl M. Wilson (to appear in COPEIA).

Notes on some Washington amphibians—James R. Slater (to appear in COPEIA).

Variation within subspecies—R. R. Huestis (a study in color variation in mice).

Recent avian food habit studies—J. Hooper Bowles (read by title).

Some details of the structure of the ear of **Squalus acanthias, S. sucklii,** and **Mustelis canis**—Lawrence E. Griffin, Reed College (slides).

Sympathetic ganglia of **Squalus sucklii**—Sidney S. Mayer and L. E. Griffin (slides).

Amphibians and reptiles of Umatilla County, Oregon—Stanley Brode (to be published in COPEIA).

This account of the meeting of the Western Division was prepared from the report of J. R. Slater, Secretary Pro-Tem.

Support of Copeia

THE Museum of Zoology of the University of Michigan is contributing to the publication expense of this number of COPEIA.

Herpetological Items

MEMBERS of the Society will be delighted to learn that a third edition of the Check List of North American Amphibians and Reptiles is being prepared by the authors, LEONHARD STEJNEGER and THOMAS BARBOUR. The second edition is exhausted.

A sufficient amount of venom having been extracted to make antivenin for some time, the Serpentarium at Tela, Honduras, has been placed on a basis of reduced activity for six months of each year. MR. STADELMAN has returned to Philadelphia, where he will remain until next winter, but snakes will always be kept at the establishment so that DIVALA SINGH can demonstrate the process of venom extraction for tourists and visitors.

The National Research Council has given DR. CHARLES E. BURT a Grant-in-Aid, to be used in the preparation of an illustrated key to the lizards of the United States and Canada. Dr. Burt plans to work during the summer at the U. S. National Museum.

MR. KARL P. SCHMIDT has been awarded a Guggenheim Fellowship, which will enable him to visit European museums and to undertake further field work in Central America. His studies are planned to include problems of herpetological distribution and systematics in Guatamela and the adjacent countries, thus supplementing the work of Dr. Dunn on lower Central America, which was also furthered by a Guggenheim Fellowship in 1928-1929.

DR. and MRS. E. R. DUNN will make further studies of the amphibians of Barro Colorado Island during the summer, and are planning a short trip into the Coclé Mountains, in the Coclé Province of Panama.

DR. DUNN wishes to receive references to any papers by Cope which are not included in Osborn's recent Biographical Memoir of Edward Drinker Cope, published by the National Academy of Sciences.

DR. EDWARD TAYLOR and HOBART SMITH have left for a collecting trip in northern Mexico.

Ichthyological Items

AMERICAN ichthyologists are happy to hear that DR. S. L. HORA is being retained as ichthyologist on the Zoological Survey of India (Indian Museum, Calcutta) and that he will thereby be enabled to continue his excellent work on Indian fishes.

DR. CECIL VON BONDE, head of the South African Fisheries Department, has just completed a tour of inspection of American fisheries institutions.

The new Oceanographic Laboratory of the University of Washington was dedicated on June 15. The building is equipped for research in oceanography, including zoology. It is expected that the activities at the laboratory will add much to our knowledge of the ecology and life histories of the North Pacific fishes.

WILLIAM C. SCHROEDER, lately of the Bureau of Fisheries, stationed at Harvard and assigned the cod migration investigation, has recently been appointed Business Manager of the new Woods Hole Oceanographic Institution. There he will continue his association with Dr. Henry B. Bigelow, and will have some time available for the extension of his cod migration studies.

On the recent annual Member's Day of the New York Zoological Society, DR. CHARLES H. TOWNSEND, director of the New York Aquarium, was presented with a bronze statue of the Townsend fur seal, as a recognition of his thirty years of service at the Aquarium.

DR. CANUTO G. MANUEL, who recently completed his training in fisheries research and economic ornithology at the University of Michigan, has begun work as Zoologist in the Bureau of Science, Manila.

DR. V. D. VLADYKOV, author of several papers on the fishes of Czechoslovakia, including a recent review of the fishes of the country, is now engaged in fisheries research for the Biological Board of Canada. He is stationed at the Atlantic Biological Station, St. Andrews, New Brunswick.

EDWIN P. CREASER, assistant in charge of the Division of Crustaceans at the University of Michigan Museum of Zoology, is now in Yucatan, collecting crustaceans, fishes, amphibians and reptiles. This work is being done under the auspices of the Carnegie Institution, cooperating with the University of Michigan. Prof. A. S. Pearse of Duke University is in charge of the party.

Recent Deaths

PROFESSOR W. C. M'INTOSH, distinguished Scotch zoologist, well known for his investigations of fishery problems, died last year.

DR. A. C. JOHANSEN, renowned Danish ichthyologist and fishery investigator, also died last year.

DR. A. BROOKER KLUGH, distinguished ecologist and hydrobiologist of Queen's University, Kingston, Ontario, died suddenly on a recent date.